EXHIBIT 21

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

STINGRAY IP SOLUTIONS, LLC Plaintiff, v. SIGNIFY N.V., ET AL Defendants.	Civil Action No. 2:21-cv-00043-JRG Civil Action No. 2:21-cv-00044-JRG

DECLARATION OF DR. ROBERT AKL, D.SC.
REGARDING CLAIM CONSTRUCTION OF
CERTAIN TERMS IN THE ASSERTED PATENTS

TABLE OF CONTENTS

I, Robert Akl, D.Sc., hereby state and declare:

I. INTRODUCTION

1. I am over the age of 18 and am competent to make this declaration. I have personal knowledge, or have developed knowledge, of these technologies based upon my education, training, and/or experience, of the matters set forth herein.

2. I have been retained by counsel for Defendant Signify N.V. ("Signify" or "Defendant"), in the above matter. I am submitting this declaration to address the meaning and construction of certain disputed terms in U.S. Patent No. 6,958,986 ("the '986 Patent"), U.S. Patent No. 6,961,310 ("the '310 Patent"), U.S. Patent No. 7,027,426 ("the '426 Patent"), U.S. Patent No. 7,082,117 ("the '117 Patent"), U.S. Patent No. 7,224,678 ("the '678 Patent"), U.S. Patent No. 7,440,572 ("the '572 Patent"), and U.S. Patent No. 7,616,961 ("the '961 Patent") (collectively, the "Asserted Patents"). For the purposes of this declaration, I have not been asked to opine on the meaning of any other terms not addressed below.

3. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those identified in this declaration. I may rely upon these materials, my knowledge and experience, and/or additional materials in forming any opinions. Further, I may also consider additional documents and information to rebut arguments raised by Plaintiff Stingray IP Sols., LLC ("Stingray" or "Plaintiff").

4. My analysis of the materials produced in this investigation is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date.

II. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

5. I am an expert in the field of wireless communication systems and networking. I have studied, taught, practiced, and researched this field for over twenty-five years. I have summarized in this section my educational background, work experience, and other relevant qualifications. Attached hereto as Appendix A, is a true and correct copy of my *curriculum vitae* describing my background and experience.

6. I earned my Bachelor of Science degrees in Electrical Engineering and Computer Science *summa cum laude* with a grade point average of 4.0/4.0 and a ranking of first in my undergraduate class from Washington University in St. Louis in 1994. In 1996, I earned my Master of Science degree in Electrical Engineering from Washington University in St. Louis with a grade point average of 4.0/4.0. I earned my Doctor of Science in Electrical Engineering from Washington University in St. Louis in 2000, again with a grade point average of 4.0/4.0, with my dissertation being on "Cell Design to Maximize Capacity in Cellular Code Division Multiple Access (CDMA) Networks."

7. While a graduate student, from 1996 through 2000, I worked at MinMax Corporation in St. Louis, where I designed software packages that provided tools to flexibly allocate capacity in a CDMA communications network and maximize the number of subscribers. I also analyzed and simulated different audio compression schemes. I also validated the hardware architecture for an Asynchronous Transfer Mode (ATM) switch capable of channel group switching, as well as performed logical and timing simulations, and developed the hardware architecture for the ATM switch. I also worked with Teleware Corporation in Seoul, South Korea, where I designed and developed algorithms that were commercially deployed in a software

package suite for analyzing the capacity in a CDMA network implementing the IS-95 standard to maximize the number of subscribers.

8. After obtaining my Doctor of Science degree, I worked as a Senior Systems Engineer at Comspace Corporation from October of 2000 to December of 2001. At Comspace, I designed and developed advanced data coding and modulation methods for improving the reliability and increasing the available data rates for cellular communications. I coded and simulated different encoding schemes (including Turbo coding, Viterbi decoding, trellis coded modulation, and Reed-Muller codes) and modulation techniques using amplitude and phase characteristics and multi-level star constellations. This work further entailed the optimization of soft decision parameters and interleavers for additive white Gaussian and Rayleigh faded channels. In addition, I also extended the control and trunking of Logic Trunked Radio (LTR) to include one-to-one and one-to-many voice and data messaging.

9. In January of 2002, I joined the faculty of the University of New Orleans in Louisiana as an Assistant Professor in the Department of Electrical Engineering. While in this position, I designed and taught two new courses called “Computer Systems Design I and II.” I also developed a Computer Engineering Curriculum with a strong hardware-design emphasis, formed a wireless research group, and advised graduate and undergraduate students.

10. In September of 2002, I received an appointment as an Assistant Professor in the Department of Computer Science and Engineering at the University of North Texas (UNT), in Denton, Texas. In May of 2008, I became a tenured Associate Professor in the Department of Computer Science and Engineering. As a faculty member, I have taught courses and directed research in networking and telecommunications, including 2G, 3G, 4G, 5G, CDMA/WCDMA, GPS, GSM, UMTS, LTE, ad-hoc networks, Bluetooth, call admission control, channel coding,

communication interfaces and standards, compression, computer architecture, MIMO systems, multi-cell network optimization, network security, packet-networks, telephony, VoIP, Wi-Fi (IEEE 802.11), IEEE 802.15.4, Zigbee, wireless communication, and wireless sensors. I am also the director of the Wireless Sensor Lab ("WiSL") at UNT. I am a member of the Center for Information and Cyber Security (CICS). It is the only program in the U.S. to be federally certified by the National Security Agency as a Center of Academic Excellence in Information Assurance Education and Research *and* Cyber Defense Research. I am also a member of the NSF Net-Centric & Cloud Software & Systems: Industry-University Cooperative Research Center (I/UCRC). Several of my research projects are funded by industry. In January of 2015, I was promoted to Associate Chair of Graduate Studies in the Department of Computer Science and Engineering.

11. In addition to advising and mentoring students at UNT, I was asked to join the faculty of the University of Arkansas in Little Rock as an Adjunct Assistant Professor from 2004 to 2008 in order to supervise the research of two Ph.D. graduate students who were doing research in wireless communications. At UNT, I have advised and supervised more than 250 undergraduate and graduate students, several of whom received a master's or doctorate degree under my guidance.

12. In addition to my academic work, I have remained active in the communication industry through my consulting work. In 2002, I consulted for Input/Output Inc. and designed and implemented algorithms for optimizing the frequency selection process used by sonar for scanning the bottom of the ocean. In 2004, I worked with Allegiant Integrated Solutions in Ft. Worth, Texas to design and develop an integrated set of tools for fast deployment of wireless networks, using the IEEE 802.11 standard. Among other features, these tools optimize the placement of Access Points and determine their respective channel allocations to minimize interference and maximize

capacity. I also assisted the Collin County Sheriff's Office (Texas) in a double homicide investigation, analyzing cellular record data to determine user location.

13. I have authored and co-authored over 90 journal publications, conference proceedings, technical papers, book chapters, and technical presentations in a broad array of communications-related technologies, including networking and wireless communication. I have also developed and taught over 100 courses related to communications and computer systems, including several courses on signals and systems, LTE, OFDM, VoIP, Wi-Fi (IEEE 802.11), IEEE 802.15.4, Zigbee, wireless communication, communications systems, communication interfaces and standards, sensor networks, source coding and compression, network security, computer systems design, game and app design, and computer architecture. These courses have included introductory courses on communication networks and signals and systems, as well as more advanced courses on wireless communications. A complete list of my publications and the courses I have developed and/or taught is also contained in my *curriculum vitae*.

14. Since 2005, I have received over a million dollars in funding from the State of Texas, Texas Higher Education Coordination Board, the National Science Foundation, and industry to design and conduct robotics, video, and mobile gaming (*e.g.*, Xbox, PC, mobile device) programming summer camps for middle and high school students at UNT. By using video and mobile gaming as the backdrop, participants have learned coding and programming principles and developed an understanding of the role of physics and mathematics in video game design.

15. My professional affiliations include services in various professional organizations and serving as a reviewer for a number of technical publications, journals, and conferences. I have also received a number of awards and recognitions, including the IEEE Professionalism Award

(2008), UNT College of Engineering Outstanding Teacher Award (2008), and Tech Titan of the Future (2010) among others, which are listed in my *curriculum vitae*.

16. I have also served as an expert in certain legal proceedings. A list of cases in which I have testified at trial, hearing, or by deposition (including those during the past five years) is provided in my *curriculum vitae* (Appendix A). Over the years, I have been retained by both plaintiffs as well as defendants.

17. I am being compensated for my work in this case at my standard rate of $750 per hour (plus reimbursement for expenses) in connection with my preparation of this report, as well as for each hour spent providing deposition or testimony. This compensation is not contingent upon my performance, the outcome of this case, or any issues involved in or related to this case. I have no financial interest in this matter.

III. MATERIALS RELIED UPON IN FORMING MY OPINIONS

18. In preparing my opinions, I have reviewed the Asserted Patents and their prosecution histories, and I have also reviewed the other documents and materials cited herein, including contemporary patents, publications, standards, and dictionary definitions. I have also reviewed the claim constructions proposed by both parties for certain disputed terms of the Asserted Patents and accompanying extrinsic evidence identified by both parties related to claim construction. When quoting from these materials, all emphasis is added unless otherwise noted.

19. My opinions are also based upon my education, training, research, knowledge, and personal and professional experience.

20. I have also previously provided declarations that relate to certain of the Asserted Patents in connection with prior litigation and *inter partes* review petitions involving Harris

Corporation and Huawei. I have also reviewed those declarations and materials I relied upon for those declarations.

IV. CLAIM CONSTRUCTION PRINCIPLES

21. I am not an attorney. Counsel has informed me about several principles and standards of patent law, which I have used in developing my opinions expressed herein.

22. I have been informed that the claims of a patent define the scope of the invention and the patentee's rights. I have been told that patent claims should be interpreted consistent with their plain and ordinary meaning as would have generally been understood by persons of ordinary skill in the art at the time a patent application was first filed, after reviewing the patent claim language, the specification, and the prosecution history (*i.e.*, the intrinsic record). In this regard, I have also been told that, in order to determine the proper meaning of a disputed claim term, I first look to the claim language itself, the specification, and the prosecution history.

23. I have been informed that a single claim term should be construed consistently with its appearance in other places in the same claim or in other claims of the same patent, unless it is clear from the specification and prosecution history that the terms have different meanings at different portions of the claims.

24. I have been informed, as a general rule, that unless a patent applicant shows an intent to limit their invention, particular examples or embodiments discussed in the specification are not to be read into the claims as limitations. I have also been told that the construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be the correct construction.

25. I have been informed that extrinsic evidence outside the patent and prosecution history, such as expert testimony, treatises and dictionaries, may also be considered as an aid in arriving at the proper construction of a claim when a claim term is ambiguous.

26. I have been informed that a patent claim is invalid as indefinite if it does not "particularly point[] out and distinctly claim[] the subject matter which the inventor or a joint inventor regards as the invention." Pre-AIA 35 U.S.C. § 112, ¶ 2. A claim, viewed in light of the specification and prosecution history, must inform those skilled in the art about the scope of the invention with reasonable certainty. However, I have been informed that reasonable certainty does not require absolute precision.

27. I understand that, under pre-AIA 35 U.S.C. § 112, ¶ 6, an element in a claim may be expressed as a means for performing a specified function without the recital of structure, material, or acts in support thereof. Such claim elements are often called "means-plus-function" claim elements and are construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. Pre-AIA 35 U.S.C. § 112, ¶ 6.

28. I further understand that patent claims may use "means for" to invoke means-plus-function treatment, but there is a rebuttable presumption that a claim element lacking the term "means" is not a means-plus-function claim element. This presumption, however, can be overcome if the claim term fails to recite sufficiently definite structure or recites function without reciting sufficient structure for performing that function. I understand that the test to determine whether a claim element falls within the ambit of pre-AIA 35 U.S.C. § 112, ¶ 6 is whether the words of the claim element are understood by persons of ordinary skill in the art at the time of the invention to have a sufficiently definite meaning as the name for structure, like a structural definition of the term well-known in the art or a definition provided in the specification.

29. I also understand that for a special purpose computer-implemented means-plus-function limitation, the structure must be more than simply a general-purpose computer or microprocessor and the specification must disclose an algorithm for performing the claimed function. I further understand that in rare circumstances a general-purpose computer without any special programming may be sufficient if the claimed computer-implemented function is a basic operation of a microprocessor, such as receiving data or storing data. Additionally, I understand that to claim a means for performing a specific computer-implemented function and then to disclose only a general-purpose computer as the structure designed to perform that function renders the claim term indefinite.

30. I further understand that a means-plus-function claim limitation may only be construed to cover the structure, material, or acts described in the specification (and equivalents thereof) that are necessary to perform the specified function in the claim. The corresponding structure must include structure that actually performs the recited function. The corresponding structure must also perform all the recited functions. Functional limitations not recited in the claim, or structural limitations from the written description that are unnecessary to perform the claimed function, should not be imported into the claim.

31. Further, it is my understanding that for computer-implemented limitations under 35 U.S.C. § 112, ¶ 6, the corresponding structure must include an algorithm sufficient to explain how the claimed function is performed. And while the algorithm may be expressed with a flowchart, a high-level flowchart that merely provides the results to be achieved and fails to describe how a computer could be programmed to produce the structure that provides the results described in the boxes is insufficient.

32. Finally, I understand that a means-plus-function claim element that lacks an adequate corresponding structure disclosure in the specification is indefinite. If a means-plus-function claim element recites multiple functions, then the specification must disclose structures corresponding to each function or it is indefinite.

V. LEVEL OF ORDINARY SKILL IN THE ART

33. I have been informed that there is a concept in patent law known as a person having ordinary skill in the art ("POSITA"). I have been informed that this concept refers to a hypothetical person who is trained in the relevant technical field of a patent without possessing extraordinary or otherwise exceptional skill. Further, I have been informed that factors such as the education level of those working in the field, the sophistication of the technology, the types of problems encountered in the art, prior art solutions to those problems, and the speed at which innovations are made may help establish the level of skill in the art.

34. Taking these factors into consideration, it is my opinion that a person having ordinary skill in the art at the time of the invention (or, in the case of patents subject to the AIA, at the time of the effective filing date) of the Asserted Patents would have had a bachelor's degree in electrical engineering, computer engineering, computer science, or a related field, and two years of experience in the design or development of wireless telecommunication systems, or the equivalent. Additional graduate education could substitute for professional experience, or significant experience in the field could substitute for formal education.

35. Based on my qualifications, including those described above and included in my *curriculum vitae*, it is my opinion that my knowledge, expertise, educational background, and experience exceeds that of a POSITA and would have also exceeded that of a POSITA at the alleged time of invention of the Asserted Patents.

36. I am and would have been familiar with the knowledge and experience a POSITA would have had at the time of the alleged invention of the Asserted Patents because of my extensive (and contemporaneous) experience in industry and as a professor where I have trained and worked with graduate students, engineers, and researchers with levels of education and experience near that of a POSITA.

VI. HIGH LEVEL OVERVIEW OF THE ASSERTED PATENTS

A. The '986 Patent

37. The '986 Patent is titled "Wireless Communication System with Enhanced Time Slot Allocation and Interference Avoidance/Mitigation Features and Related Methods" and is directed to a wireless communications network including a plurality of mobile nodes. '986 Patent at Abstract. More specifically, the '986 Patent is directed to scheduling semi-permanent time slots to establish communication links with neighboring mobile nodes for transmitting data therebetween, determining link utilization metrics, and scheduling additional demand assigned time slots based upon the link utilization metrics. *Id.*

B. The '310 Patent

38. The '310 Patent is titled "Multiple Path Reactive Routing in Mobile Ad Hoc Network" and is directed to a mobile ad hoc network in which different routes from a source node to a destination node are discovered, the routes are ranked based on at least one "link metric," and data is transferred from a source node to a destination node along a plurality of the discovered routes based on the ranking. '310 Patent at Abstract.

C. The '426 Patent

39. The '426 Patent is titled "Multi-Channel Mobile Ad Hoc Network" and is directed to a mobile ad hoc network that includes a plurality of mobile nodes that are connected by communication links and which communicate with each other over a plurality of channels. '426

Patent at Abstract. More specifically, the patent is directed to sending a route request over each of a plurality of channels in a mobile ad hoc network to discover routing to a destination node and then selecting at least one of the plurality of channels to send data over. *Id.* at 2:44-56.

D. The ’117 Patent

40. The ’117 Patent is titled “Mobile Ad-Hoc Network with Intrusion Detection Features and Related Methods” and is directed to a mobile ad-hoc network that includes a plurality of nodes for transmitting data and a policing node for detecting intrusions into the mobile ad-hoc network. ’117 Patent at Abstract. The specification of the ’117 Patent is substantially identical to the specification of the ’678 Patent, though they are not technically family members. More specifically, the patent is directed to a policing node for detecting intrusions into the network by monitoring transmissions between the nodes and generating an intrusion alert when an intrusion into the mobile ad-hoc network is detected. *Id*.

E. The ’678 Patent

41. The ’678 Patent is titled “Wireless Local or Metropolitan Area Network with Intrusion Detection Features and Related Methods” and is directed to a wireless local or metropolitan area network that includes a plurality of stations for transmitting data using a media access layer and a policing station for detecting intrusions into the network. ’678 Patent at Abstract. The specification of the ’678 Patent is substantially identical to the specification of the ’117 Patent, though they are not technically family members. More specifically, the patent is directed to a policing station for detecting intrusions into the network by monitoring transmissions between the stations and generating an intrusion alert when an intrusion into the network is detected. *Id*.

F. The ’572 Patent

42. The ’572 Patent is titled “Secure Wireless LAN Device and Associated Methods” and is directed to a LAN device with a housing, a wireless transceiver, a medium access controller,

and a cryptography circuit all carried by the housing. ’572 Patent at Abstract. More specifically, the device’s cryptography circuit is capable of encrypting both address and data information for transmissions, and decrypting both address and data information upon reception using a plurality of encrypting bits. *Id*.

G. The ’961 Patent

43. The ’961 Patent is titled “Allocating Channels in a Mobile Ad Hoc Network” and is directed to a mobile ad hoc network with a plurality of wireless mobile nodes and a plurality of wireless communication links connecting the plurality of nodes together over a plurality of channels. ’961 Patent at Abstract. Additionally, each node monitors link performance on a first channel and each node scouts one or more other available channels when the monitored link performance of the first channel falls below a QoS threshold. *Id*.

VII. DISPUTED CLAIM TERMS

A. “mobile node(s)” (’986 Patent Claims 9 and 25, ’310 Patent Claim 13, ’426 Patent Claims 8 and 18, ’961 Patent Claim 1)

Signify’s Construction	Stingray’s Construction
a node that is movable while in use; not a fixed node	a device in a wireless communications network that can be moved

44. It is my understanding that the term “mobile node(s)” appears in several of the Asserted Patents and that, while Stingray disputes whether the term is limiting or not depending on whether it appears in a claim preamble, the parties agree that this term should have the same construction across all patents in which it appears. Accordingly, I have considered this term in view of each of the specifications in which the term appears as well as the understanding of a POSITA.

45. It is my opinion that a POSITA would have understood “mobile node” to refer to a node that is movable while in use and that this term cannot encompass a fixed node. While the

parties apparently agree that the node must be movable and cannot encompass a fixed node, Stingray's construction does not state that the node must be movable while in use (and does not include an express prohibition on the node being a fixed node). Accordingly, as further discussed below, I believe that Stingray's proposed construction is insufficient because it does not fully encapsulate the meaning of "mobile node" and would improperly include products that are not "mobile nodes." For example, while an 8-foot-long base station antenna for a cellular tower is a "device in a wireless communications network" and these antennas are commonly shipped on trucks for installation and therefore "can be moved," no POSITA would consider such a device to be a "mobile node" because it is intended to be used in a fixed location and is not movable while in use. A POSITA would have understood that a wireless device that could be moved to a new location between uses but which cannot be used while in motion would not qualify as a mobile node.

46. A POSITA would have understood that a mobile node must not only be movable but must also be movable while being operated, or, stated differently, that a mobile node must be capable of being used while in motion. For example, the IEEE 802.11 standard from 1999 defines "mobile station" as "[a] type of station that uses network communications ***while in motion***." SIGNIFYCC_00000832 ("IEEE 802.11-1999 Specification") at 3.34; *see also* SIGNIFYCC_00001354 ("IEEE 802.15.4-2003 Specification") at 3.21 (defining "mobile device" as "a device that uses network communication ***while in motion***"). Both the IEEE 802.11 standard and the 802.15.4 standard were widely known wireless networking standards that were undergoing drafting in the late 1990s and early 2000s and would have been well known to a POSITA at or around the time of the invention of the Asserted Patents.

47. Further, this standard further makes clear that simply being movable (but not usable in motion) does not mean that something is a "mobile" node because such nodes are defined as "portable." Specifically, the IEEE 802.11-1999 Specification states that "[a] portable station is one that is moved from location to location, but that is only used while at a fixed location. Mobile stations actually access the LAN while in motion." SIGNIFYCC_00000836. Accordingly, while Stingray's proposed construction may sufficiently convey the meaning of a portable node, its construction is insufficient to accurately describe a mobile node.

48. Mobile phones and laptops were examples of the types of wireless stations commonly referred to as "mobile nodes" around the time of the alleged invention of the Asserted Patents. *See, e.g.*, '117 Patent at 5:30-37 (providing the following examples of mobile nodes in a mobile ad-hoc network: "laptop computers, personal data assistants (PDAs), cellular telephones, or other suitable devices, as will be appreciated by those of skill in the art"). Importantly, such products contain a battery that allows them to maintain power and communicate wirelessly while in motion. *See, e.g.*, SIGNIFYCC_00000022 (defining "mobile computing" as "the process of using a computer while traveling. Mobile computing usually requires a battery-powered portable computer rather than a desktop system"). A device without a battery that would need to be hard-wired to a power source in order to communicate wirelessly would not have been considered a "mobile node," but Stingray's proposed construction arguably attempts to capture such products so long as they can be connected to such a power source after movement. A POSITA would not, for example, consider a desktop computer a "mobile node" because it could be carried to another office. This is another reason why a POSITA would find Stingray's proposed construction improper.

49. Finally, Signify's construction is also consistent with contemporaneous dictionary definitions of "mobile" and of devices that would have been considered mobile nodes. For example, the Academic Press Dictionary of Science and Technology defines "mobile" as "able to move or to be moved about" and "mobile radio" as "[r]adio service between a stationary location and at least one mobile radio station, or between mobile stations." SIGNIFYCC_00002149. Moreover, the Oxford American College Dictionary defines "mobile" as "able to move or be moved freely or easily." SIGNIFYCC_00000052. *See also* SIGNIFYCC_00000064 (defining "mobile" as "capable of moving or being moved readily"); SIGNIFYCC_00000075 (defining "mobile" as "capable of moving of being moved: moveable"). Accordingly, a POSITA would have understood that a mobile node must be movable while in use and not a fixed node.

B. "mobile ad hoc network" or "MANET" ('310 Patent Claim 13, '426 Patent Claims 8 and 18, '117 Patent Claims 24 and 55, '961 Patent Claim 1)

Signify's Construction	Stingray's Construction
a network consisting of only a number of geographically-distributed, mobile nodes wirelessly connected by one or more radio frequency channels, which lacks any fixed infrastructure	Preamble is not limiting; Alternatively, if construed: "a network consisting of a number of geographically-distributed, potentially mobile nodes wirelessly connected by one or more radio frequency channels, which lacks fixed infrastructure such that nodes must self-organize and reconfigure as they move, join or leave the network"

50. It is my understanding that the term "mobile ad hoc network" (also abbreviated as "MANET") appears in several of the Asserted Patents and that, while Stingray disputes whether the term is limiting or not depending on whether it appears in a claim preamble, the parties agree that this term should have the same construction across all patents in which it appears.

Accordingly, I have considered this term in view of each of the specifications in which the term appears as well as the understanding of a POSITA.

51. I understand that Signify has proposed that "mobile ad hoc network" means "a network consisting of only a number of geographically-distributed, mobile nodes wirelessly connected by one or more radio frequency channels, which lacks any fixed infrastructure." I also understand that Stingray has said that this preamble is not limiting and that no construction is necessary.

52. Additionally, I understand that Stingray has offered an alternative construction, construing the term as "a network consisting of a number of geographically-distributed, potentially mobile nodes wirelessly connected by one or more radio frequency channels, which lacks fixed infrastructure such that nodes must self-organize and reconfigure as they move, join or leave the network"

53. Thus, I understand that the parties agree that if the term is construed, a MANET is at least "a network consisting of a number of geographically-distributed . . . nodes wirelessly connected by one or more radio frequency channels, which lacks fixed infrastructure" and disagree as to whether the construction should include the phrase "***only*** a number of geographically-distributed, mobile nodes" or "a number of geographically-distributed, ***potentially*** mobile nodes," and whether the lack of fixed infrastructure further requires the limitation "such that nodes must self-organize and reconfigure as they move, join or leave the network."

54. As an initial matter, I agree with Signify that construction of this term is necessary because a juror may be confused and believe that any network that is "wireless" that a wireless device can join at will is inherently a "mobile ad-hoc network" which a POSITA would understand is not true. While the phrase is commonly used in the art and is defined in the Asserted Patents, it

is a technical phrase not commonly used outside the relevant fields, and therefore, it is my belief that construing the phrase would be helpful to a jury.

55. A POSITA would have understood that one of the main distinguishing features of a mobile ad-hoc network (compared to other types of wireless networks) is its lack of any fixed infrastructure connecting its mobile nodes together. This is supported by language in the Asserted Patents as well as contemporary publications and patents.

56. Signify's construction closely resembles the language in the specification of the '310 Patent itself, which states:

> Physically, ***a mobile ad hoc network includes a number of geographically-distributed, potentially mobile nodes wirelessly connected by one or more radio frequency channels. Compared with other type of networks, such as cellular networks or satellite networks, the most distinctive feature of mobile ad hoc networks is the lack of any fixed infrastructure.*** The network is ***formed of mobile nodes only,*** and a network is created on the fly as the nodes transmit to or receive from other nodes.

'310 Patent at 1:12-20.

57. While Stingray may object to the absence of the word "potentially" in Signify's construction, a POSITA would understand that the above passage's use of "potentially mobile" refers only to the fact that that the claimed mobile nodes need not actually *be in motion* to constitute a mobile ad-hoc network, but those mobile nodes must still meet the definition of "mobile nodes" as I have previously opined, meaning that they must be *capable* of use while in motion (or, stated differently, capable of being moved while in use). Accordingly, the prior construction I have provided for "mobile node" moots this objection since the term "mobile node" is used in this construction.

58. Additionally, while Stingray may object to the addition of the term "only" in Signify's construction, a POSITA would have understood that a MANET only included mobile nodes. Such an understanding is explicitly confirmed by the '310 Patent, which states that the

"network is formed of mobile nodes only" and that the "most distinctive feature of mobile ad hoc networks is the lack of *any* fixed infrastructure." *Id.* at 1:16-19.

59. Further, Signify's construction is congruent with the way a POSITA would have understood the term. For example, *MANETconf: Configuration of Hosts in a Mobile Ad Hoc Network* states:

> ***A mobile ad hoc network (MANET) is a group of mobile, wireless nodes which cooperatively and spontaneously form an IP-based network. This network is independent of any fixed infrastructure or centralized administration.*** A node communicates directly with nodes within its wireless communication range. Nodes that are part of the MANET, but beyond each other's wireless range communicate using a multi-hop route through other nodes in the network.

SIGNIFYCC_00000802.

60. Additionally, U.S. Patent No. 6,850,532, filed on September 20, 2002 describes the MANET Working Group's definition of "mobile ad hoc network," which is congruent with the understanding a POSITA would have had of the term:

> According to the MANET Working Group, the "mobile ad hoc network" (MANET) is an autonomous system of mobile routers (and associated hosts) connected by wireless links—the union of which form an arbitrary graph. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably.

'532 Patent at 1:23-30.

61. Therefore, a POSITA would understand "mobile ad hoc network" to be "a network consisting of only a number of geographically-distributed, mobile nodes wirelessly connected by one or more radio frequency channels, which lacks any fixed infrastructure" and that construing the phrase accordingly (in view of the above construction of the term "mobile node") is correct and would be helpful to a jury.

62. Finally, in view of the parties' agreed construction stating that the MANET lacks any fixed infrastructure, a POSITA would not have found it necessary to further add, "such that

nodes must self-organize and reconfigure as they move, join, or leave the network." Such a construction would be redundant and unnecessary in aiding the jury in understanding this term.

C. The '310 Patent

1. "link metric" (Claim 13)

Signify's Construction	Stingray's Construction
Indefinite	measure of a link attribute (such as delay, capacity, available capacity, or reliability)

63. I understand that claim 13 recites the term "link metric." I further understand that Signify contends that the term is indefinite while Stingray, after initially proposing that no construction was necessary or that the claim language should be accorded its plain and ordinary meaning, now contends that the term should be construed as a "measure of a link attribute (such as delay, capacity, available capacity, or reliability)."

64. It is my opinion that the phrase "link metric," when read in light of the specification, would not have allowed a POSITA to understand the bounds of the term with reasonable certainty.

65. The specification states that a "link metric" "may include a measurement of link delay, link capacity, link available capacity, and/or link reliability." '310 Patent at Abstract. However, the specification fails to denote the bounds of what is and is not a link metric, which was not a term of art. Though I agree with Stingray that the idea of a "metric" requires a measurement, a POSITA would have been unable to ascertain whether certain possible measurements would or would not be considered a link metric. For example, it would be unclear to a POSITA exactly what types of parameters or measurements regarding a wireless connection would qualify as a "link metric." It is not at all clear whether, for example, an IP address or an SSID would qualify as a "link metric," or if the type of encryption used by the connection, the channel that the link is communicating on, or the assigned frequency for the link would so qualify.

Therefore, it is my opinion that a POSITA would not have understood the phrase "link metric" with reasonable certainty because its bounds are not defined by the specification and it is not a term of art with a normally understood meaning.

66. Stingray's attempt to add definiteness to this term through their proposed construction does nothing to further define the bounds of the term and instead highlights its indefiniteness. Firstly, the parenthetical portion of the construction, "such as delay, capacity, available capacity, or reliability" not only does not limit the term but simply provides examples of things that might be an embodiment of a "link metric" listed in the specification, but the term "such as" provides no limitation at all. *See, e.g.*, '310 Patent at Abstract. As mentioned above, the problem is not that the specification fails to list examples of a "link metric"; rather, the scope of the claim is undefined. The remainder of Stingray's construction, that the term is a "measure of a link attribute" similarly does nothing to narrow the scope of the claims or provide boundaries by which a POSITA would understand the scope of the claim with reasonable certainly. Instead, Stingray's construction simply replaces the "metric" in "link metric" with "attribute" which is subject to the exact same problems mentioned above. A POSITA would still not know, for example, whether the type of encryption used by the connection, the channel that the link is communicating on, or the assigned frequency for the link would so qualify as a metric of the link under Stingray's proposed construction.

67. While I understand that Stingray has previously suggested that the terms "link metric" and "link utilization metric" might be synonymous, I disagree. I believe that the term "link metric" is a broader term than "link utilization metric," and the list of examples of "link metrics" provided in the '310 Patent encompass other metrics that I understand are not "link utilization

metrics," such as link delay. Accordingly, though the term "link utilization metric" is not indefinite because its scope can be understood, the term "link metric" standing alone remains indefinite.

D. The '426 Patent

1. "a route discovery unit to transmit route requests of each of the plurality of electrically separate channels to discover routing to a destination node" (Claim 18)

Signify's Construction	Stingray's Construction
Governed by Pre-AIA 35 U.S.C. 112 Paragraph 6 **Function:** transmit route requests of each of the plurality of electrically separate channels to discover routing to a destination node **Structure:** Indefinite for lack of corresponding structure.	Plain and ordinary meaning; this term is not subject to pre-AIA 35 U.S.C. 112 paragraph 6. Alternatively, if governed by Pre-AIA 35 U.S.C. 112 Paragraph 6: Function: transmit route requests over each of the plurality of electrically separate channels to discover routing to a destination node

68. I understand that Signify states that this term is a means-plus-function term in which the function is "transmit[ting] route requests of each of the plurality of electrically separate channels to discover routing to a destination node." I further understand that Signify contends that the patent does not state a corresponding structure for the above-mentioned function. I also understand that Stingray states that the term should be accorded its plain and ordinary meaning and that the term is not a means-plus-function term. Additionally, I understand that Stingray offers an alternative construction if the court finds that the claim is a means-plus-function term. In their alternative construction, they agree with Signify's construction of the function of the term but, as of the time of this declaration, have not proposed any structure that would perform the claimed function. If Stingray later attempts to propose a structure that it alleges performs the claimed function, I reserve the right to consider and respond to that proposal.

69. As a preliminary matter, it is my opinion that the term is a means-plus-function term because the phrase "route discovery unit" would not have been understood by a POSITA as having a well understood structural meaning and is not a term used in the art. Rather the term "unit" is simply a generic, or nonce term, that would have been understood by a POSITA as simply a substitute for the phrase a "means for."

70. Further, nothing in the claim or the specification of the '426 Patent clarifies or elaborates on the structure such that a POSITA would have understood "route discovery unit" to convey sufficiently definite structure. The remainder of the relevant portion of claim 18 simply discusses the function of a route discovery unit. Moreover, rather than adding sufficiently definite structure, the specification makes it clear that the term is simply a generic description for software or hardware that performs a specified function. Specifically, the specification states:

> As will be appreciated by those skilled in the art, portions of the present invention may be embodied as a method, data processing system, or computer program product. Accordingly, these portions of the present invention may take the form of ***an entirely hardware embodiment, an entirely software embodiment, or an embodiment combining software and hardware aspects.*** Furthermore, portions of the present invention may ***be a computer program product on a computer-usable storage medium having computer readable program code on the medium.*** Any suitable computer readable medium may be utilized including, but not limited to, static and dynamic storage devices, hard disks, optical storage devices, and magnetic storage devices.

'426 Patent at 4:15-27.

Further, the only portion of the specification the discloses anything regarding the claimed "route discovery unit" does so purely functionally, without providing any further structure or algorithm:

> As shown in FIG. 7, ***the controller 44 includes a route discovery unit 50 to transmit route requests RREQ over each of the plurality of channels to discover routing to the destination node D***, and a route selection unit 52 to select a route to the destination node on at least one of the plurality of channels. ***The route discovery unit 50 may send the route request over each of the plurality of channels sequentially***, and the route request may include a channel identifier. The selected route to the destination node may include more than one of the plurality of channels.

Id. at 6:45-54 ; *see also* Fig. 7, below:

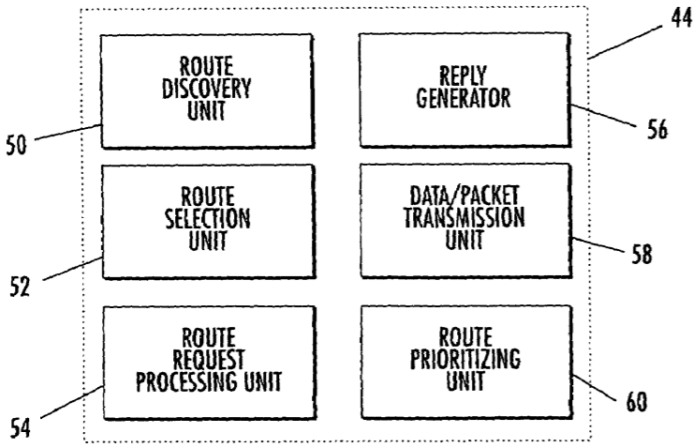

FIG. 7.

71. Moreover, in describing route discovery generally, the specification states only that route requests "RREQ" are sent to all intermediate nodes within one hop of the source node over all existing channels. *Id.* at 5:3-18. Then, on each channel "route discovery proceeds as usual" with nodes determining whether they can support a particular route request and if they can, forwarding the request to other intermediate nodes. *Id.* at 5:19-31. This section of the specification is similar to the functional language described above, and it still fails to provide any structure or algorithm that could be considered sufficient structure. Stated differently, these paragraphs provide results or functions (the transmitting of route requests) without stating any structure that could be used to produce the results. Accordingly, because the claimed "route discovery unit" is simply a generic term that fails to convey sufficiently definite structure and the specification includes no structure or algorithm for performing the recited function, the above term is a means-plus-function term that is indefinite for failure to include corresponding structure.

72. Accordingly, I agree with Signify that the specification fails to identify any corresponding structure or algorithm for the function of "transmit[ting] route requests of each of

the plurality of electrically separate channels to discover routing to a destination node." The specification does nothing more than "parrot the function," which I understand is insufficient to disclose an algorithm.

2. "a route selection unit to select a route to the destination node on at least one of the plurality of electrically separate channels" (Claim 18)

Signify's Construction	Stingray's Construction
Governed by Pre-AIA 35 U.S.C. 112 Paragraph 6 **Function:** select a route to the destination node on at least one of the plurality of electrically separate channels **Structure:** Indefinite for lack of corresponding structure.	Plain and ordinary meaning; this term is not subject to pre-AIA 35 U.S.C. 112 paragraph 6. Alternatively, if governed by Pre-AIA 35 U.S.C. 112 Paragraph 6: Function: select a route to the destination node on at least one of the plurality of electrically separate channels

73. I understand that Signify states that this term is a means-plus-function term in which the function is "select[ing] a route to the destination node on at least one of the plurality of electrically separate channels." I further understand that Signify contends that the patent does not state a corresponding structure for the above-mentioned function. I also understand that Stingray states that the term should be accorded its plain and ordinary meaning and that the term is not a means-plus-function term. Additionally, I understand that Stingray offers an alternative construction if the court finds that the claim is a means-plus-function term. In their alternative construction, they agree with Signify's construction of the function of the term but, as of the time of this declaration, have not proposed any structure that would perform the claimed function. If Stingray later attempts to propose a structure that it alleges performs the claimed function, I reserve the right to consider and respond to that proposal.

74. For substantially similar reasons as those I have mentioned above with respect to a "route discovery unit," it is my opinion that this term is a means-plus-function term.

75. Similarly to a "route discovery unit," the term "unit" in "route selection unit" is nothing more than a generic, or nonce term, that would have been understood by a POSITA as simply a substitute for the phrase a "means for." Accordingly, I incorporate my above reasoning regarding why the related term "route discovery unit" fails to convey sufficiently definite structure into this section. Accordingly, this term is also a means plus function term. Here, the phrase "route selection unit to" is essentially the same as a "unit for selecting a route by . . ." or "means for selecting a route by . . ."

76. Moreover, the specification fails to recite any corresponding structure for the function of "select[ing] a route to the destination node on at least one of the plurality of electrically separate channels." The same portion of the specification that describes "route discovery unit," describes "route selection unit," and just as with "route discovery unit," the language is entirely functional, providing insufficient structure:

> As shown in FIG. 7, the controller 44 includes a route discovery unit 50 to transmit route requests RREQ over each of the plurality of channels to discover routing to the destination node D, and ***a route selection unit 52 to select a route to the destination node on at least one of the plurality of channels***. The route discovery unit 50 may send the route request over each of the plurality of channels sequentially, and the route request may include a channel identifier. ***The selected route to the destination node may include more than one of the plurality of channels***.

Id. at 6:45-54; *see also* Figure 7, below:

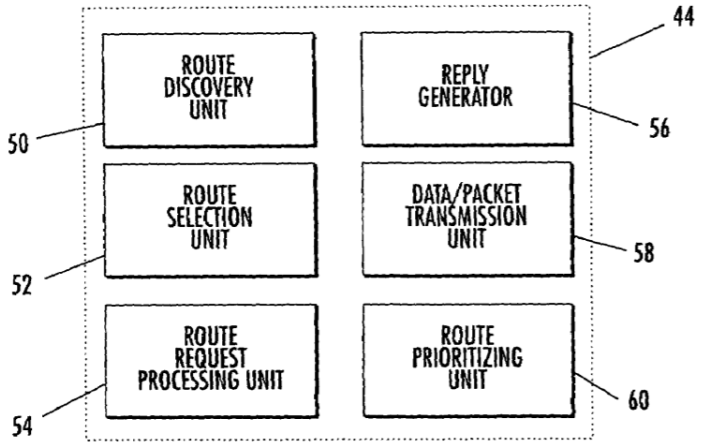

FIG. 7.

77. Further, in describing route selection generally, the specification yet again uses purely functional language, stating only a "source node S then ***selects a route to the destination node D based upon the route metrics***, and preferably transmits route confirmations CONFQ to intermediate nodes on the selected route." *Id.* at 5:60-63. Clearly, this phrase includes no structure or algorithm that a POSITA would understand could perform the claimed function and does not provide an algorithm explaining to a POSITA how to select a route "based upon the route metrics." Accordingly, I agree with Signify that the term "route selection unit" fails to convey sufficiently definite structure and the specification includes no structure or algorithm for performing the recited function; therefore, the above term is a means-plus-function term that is indefinite for failure to include corresponding structure.

E. The '117 Patent

1. "operating in a contention-free mode" (Claims 24 and 55)

Signify's Construction	Stingray's Construction
operating with channel usage controlled by a designated control node without contending for channel access	operating in a manner wherein channel usage is controlled such that nodes do not need to contend for channel access

78. I understand that Signify has proposed that "operating in a contention-free mode" means "operating with channel usage controlled by a designated control node without contending for channel access." I also understand that Stingray states that the term means "operating in a manner wherein channel usage is controlled such that nodes do not need to contend for channel access,"

79. Signify's construction closely resembles the language in the specification of the patent itself, which states:

> In accordance with another embodiment of the MANET 40 illustrated in FIG. 4, the nodes 41, 42 may operate in contention or contention-free modes. That is, in a contention mode ***all network nodes are required to contend for access*** to the particular channel being used for each packet of data that is transmitted. ***During a contention-free period (CFP), channel usage is controlled by a designated control node, which thus eliminates the need for nodes to contend for channel access.*** In the case of MANETs having nodes arranged in groups or clusters, a cluster leader node may designate when a CFP is to be implemented, for example, as will be appreciated by those of skill in the art.

'117 Patent at 7:6-17.

80. Further, both Signify's construction and the almost identical text in the specification are congruent with the way a POSITA would have understood the term. The use of a specifically designated control node during contention-free mode operation is a critical and distinguishing feature of such operation, because without such a control node the nodes would be unable to operate without contending for channel access. Furthermore, the requirement that the nodes operate "without contending for channel access" is a defining feature of "contention-free" operation.

81. By way of contrast, the *Microsoft Press Computer Dictionary* (1991) defines "contention" as:

> On a network, competition among stations for the opportunity to use a communications line or network resource. In one sense, contention describes a situation in which two or more devices attempt to transmit at the same time, thus

> causing a collision on the line. In a somewhat different sense, contention also describes a free-for-all method of controlling access to a communications line, in which the right to transmit is awarded to the station that wins control of the line. In this type of contention, each station listens to the line and waits for it to become inactive. When the line is free, any station that wants to transmit bids for the line by sending a request-to-send message to its intended recipient. If the response is positive, the station is free to transmit, and all other nodes must wait until the line is free again before attempting any transmissions of their own. With contention, stations do not transmit in any particular order, nor do they use possession of a special signal (token) to determine which station currently has the right to use the line.

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82. Therefore, it is my opinion that a POSITA would understand "operating in a contention-free mode" to be "operating with channel usage controlled by a designated control node without contending for channel access."

83. I disagree with Stingray's proposal as it fails to include the requirement of a designated control node that a POSITA would understand is a requirement of operating in a contention-free mode, and further attempts to include periods where nodes do not *need* to content for channel access, but still *might*. A POSITA would understand that such a mode of operation would not qualify as a contention-*free* mode.

2. "contention-free period(s)"/"CFP(s)" (Claims 24 and 55)

Signify's Construction	Stingray's Construction
a period of time during which channel usage is controlled by a designated control node and nodes do not contend for chancel access	period(s) designated for operation in a contention-free mode

84. I understand that Signify has proposed that "contention-free period" / "CFPs" means "a period of time during which channel usage is controlled by a designated control node and nodes do not contend for chancel access." I also understand that Stingray states that the term means "period(s) designated for operation in a contention-free mode,"

85. For substantially identical reasons to the opinions I have just expressed with respect to "operating in a contention-free mode," I agree with Signify's proposed construction. Signify's construction closely resembles the language in the specification of the patent itself, which states:

> In accordance with another embodiment of the MANET 40 illustrated in FIG. 4, the nodes 41, 42 may operate in contention or contention-free modes. That is, in a contention mode ***all network nodes are required to contend for access*** to the particular channel being used for each packet of data that is transmitted. During a contention-free period (CFP), channel usage is controlled by a designated control node, which thus eliminates the need for nodes to contend for channel access. In the case of MANETs having nodes arranged in groups or clusters, a cluster leader node may designate when a CFP is to be implemented, for example, as will be appreciated by those of skill in the art.

'117 Patent at 7:6-17.

86. Further, both Signify's construction and the almost identical text in the specification are congruent with the way a POSITA would have understood the term. For example, *Microsoft Press Computer Dictionary* (1991) defines "contention" as:

> On a network, competition among stations for the opportunity to use a communications line or network resource. In one sense, contention describes a situation in which two or more devices attempt to transmit at the same time, thus causing a collision on the line. In a somewhat different sense, contention also describes a free-for-all method of controlling access to a communications line, in which the right to transmit is awarded to the station that wins control of the line. In this type of contention, each station listens to the line and waits for it to become inactive. When the line is free, any station that wants to transmit bids for the line by sending a request-to-send message to its intended recipient. If the response is positive, the station is free to transmit, and all other nodes must wait until the line is free again before attempting any transmissions of their own. With contention, stations do not transmit in any particular order, nor do they use possession of a special signal (token) to determine which station currently has the right to use the line.

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87. Therefore, it is my opinion that a POSITA would understand "contention-free period(s)" / "CFPs" to be "a period of time during which channel usage is controlled by a

designated control node and nodes do not contend for chancel access" and that construing the phrase accordingly would be helpful to a jury.

88. I disagree with Stingray's proposal as it fails to include the express requirement of a designated control node that a POSITA would understand is a requirement of operating in a contention-free period, and because (as previously stated) I disagree with Stingray's construction of contention-free mode on which their construction depends.

3. "a policing node for detecting intrusions into the MANET by monitoring transmissions among said plurality of nodes to detect contention-free mode operation outside of a CFP; and generating an intrusion alert based upon detecting contention-free mode operation outside a CFP" (Claim 24)

Signify's Construction	Stingray's Construction
Governed by Pre-AIA 35 U.S.C. 112 Paragraph 6 **Function:** detecting intrusions into the MANET by monitoring transmissions among said plurality of nodes to detect contention-free mode operation outside of a CFP; and generating an intrusion alert based upon detecting contention-free mode operation outside a CFP **Structure:** Indefinite for lack of corresponding structure.	Plain and ordinary meaning; this term is not subject to pre-AIA 35 U.S.C. 112 paragraph 6. Alternatively, if governed by Pre-AIA 35 U.S.C. 112 Paragraph 6: Function: detecting intrusion into the MANET

89. I understand that Signify states that this term is a means-plus-function term in which the function is "detecting intrusion into the MANET by monitoring transmissions among said plurality of nodes to detect contention-free mode operation outside of a CFP; and generating an intrusion alert based upon detecting contention-free mode operation outside a CFP." I further understand that Signify contends that the patent does not state a corresponding structure for the above-mentioned function. I also understand that Stingray states that the term should be accorded

its plain and ordinary meaning and that the term is not a means-plus function term. Additionally, I understand that Stingray offers an alternative construction if the court finds that the claim is a means-plus-function term. In their alternative construction, Stingray agrees with Signify's construction requiring "detecting intrusions into the MANET" but does not agree with the remainder of Signify's construction. Further, as of the time of this declaration, Stingray has not proposed any structure that would perform the claimed function. If Stingray later attempts to propose a structure that it alleges performs the claimed function, I reserve the right to consider and respond to that proposal.

90. As a preliminary matter, it is my opinion that the term is a means-plus-function term because the phrase "policing node" would not have been understood by a POSITA as having a well understood structural meaning and is not a term used in the art. Rather the term "policing node for" is simply a generic, or nonce term, that would have been understood by a POSITA as simply a substitute for the phrase a "means for policing by."

91. Further, nothing in the claim or the specification of the '117 Patent clarifies or elaborates on the structure such that a POSITA would have understood "policing node" to convey sufficiently definite structure. The remainder of the relevant portion of claim 24 simply discusses the function of a policing node. Moreover, rather than adding sufficiently definite structure, the specification makes it clear that the term is simply a generic description for software or hardware that performs a specified function. Specifically, the specification provides only the following relevant disclosures:

> It will also be appreciated that the above-described invention may be implemented in several ways. For example, ***the policing node 13 could be implemented in one or more separate, dedicated devices*** that are not already part of the MANET 10. ***Alternately, the invention may be implemented in software*** to be installed on one or more existing nodes in a MANET where intrusion detection is desired.

'117 Patent at 10:52-58.

> Thus, the ***policing node 43 may advantageously detect intrusions into the MANET 40 by monitoring transmissions among the nodes 41, 42 to detect contention-free mode operation outside of a CFP. As such, an intrusion alert may be generated by the policing node 43 based upon such detection.*** In other words, detection of a node operating in contention-free mode outside of a CFP indicates that this node is not an authorized node, as all authorized nodes will be informed by the designated control node when a CFP has been instituted.

'117 Patent, 7:18-27; *see also* Fig. 4, below (defining "Policing Node 43" purely in terms of the function it performs):

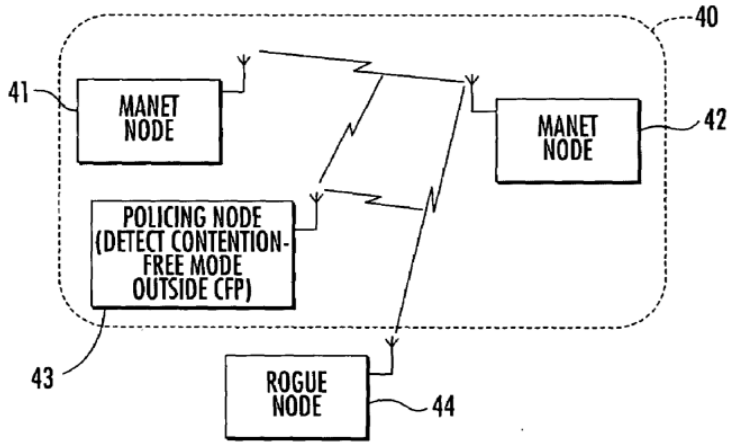

FIG. 4.

No particular hardware or software is ever enabled or described. Accordingly, because the term "policing node" is simply a generic term that fails to convey sufficiently definite structure, the above term is a means-plus-function term.

92. Further, I agree with Signify that the specification fails to identify any corresponding structure for the function of "detecting intrusion into the MANET by monitoring transmissions among said plurality of nodes to detect contention-free mode operation outside of a CFP; and generating an intrusion alert based upon detecting contention-free mode operation outside a CFP."

93. For these and for substantially similar reasons as those mentioned above with respect to the "policing node for . . . " term of the '117 Patent, it is my opinion that this term is a

means-plus-function term and that the specification lacks corresponding structure for performing the claimed function.

94. I disagree with Stingray's proposed function for this term because it does not include the entire claimed function of the policing node means, but simply recites a short portion of that function. I understand that in a means-plus-function claim limitation, the identified structure must perform the entire claimed function and not just a portion of it.

4. "intrusion alert" (Claims 24 and 55)

Signify's Construction	Stingray's Construction
a notification generated and sent by the policing node(s) upon detecting an attempted intrusion	a notification indicating detection of an anomaly or abnormal event

95. I understand that Signify has proposed that "intrusion alert" means "a notification generated and sent by the policing node(s) upon detecting an attempted intrusion." I further understand that Stingray has proposed that the term means "a notification indicating detection of an anomaly or abnormal event."

96. I agree with Signify's proposed construction and I believe that Stingray's proposed construction is overbroad and would encompass notifications that are not "intrusion alerts" but are simply error messages or other notifications regarding abnormal events. While detected intrusion attempts are generally anomalous or abnormal events, it is not the case that all notifications of anomalous or abnormal events are notifications of attempted intrusions. Thus, while Stingray appears to be relying upon a section of the '117 Patent specification that states:

> Moreover, intrusion detection is based upon anomaly detections, such as the detection of abnormal updates to routing tables or anomalies in certain network layers, such as with media access control (MAC) layer protocols.

'117 Patent at 2:4-8. It is not the case that all detected anomalies or abnormal updates are signs of attempted intrusions or that notifications of such anomalies are necessarily intrusion alerts.

Accordingly, I disagree with Stingray's proposed construction as overly broad because it attempts to capture notifications that are not intended as notifications of attempted ***intrusions***, including, for example, error notifications.

97. Signify's construction is further supported by other language in the specification of the patent itself, which states:

> The policing node may advantageously transmit an intrusion alert to at least one of the plurality of nodes in some embodiments. As such, the appropriate countermeasures may be taken to respond to the intrusion.

'117 Patent at 3:11-14.

98. Further, both Signify's construction and the almost identical text in the specification are congruent with the way a POSITA would have understood the term. For example, the *Encyclopedia of Technology Terms*, Que Publishing (2002) defines "intrusion detection" as:

> a type of security management system for computers and networks. An ID system gathers and analyzes information from various areas within a computer or a network to identify possible security breach, which include both intrusions (attacks from outside the organization) and misuse (attacks from within the organization). ID uses vulnerability assessment (sometimes referred to as scanning, which is a technology developed to assess the security of a computer system. Intrusion detection functions include: monitoring and analyzing both user and system activities; analyzing system configurations and vulnerabilities; assessing system and file integrity; ability to recognize patterns typical of attacks; analysis of abnormal activity patterns; tracking user policy violations.

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99. Therefore, it is my opinion that a POSITA would understand "intrusion alert" to be "a notification generated and sent by the policing node(s) upon detecting an attempted intrusion."

F. The '678 Patent

1. "a policing station for detecting intrusions into the wireless network by monitoring transmissions among said plurality of stations to detect failed attempts to authenticate MAC addresses; and generating an

intrusion alert based upon detecting a number of failed attempts to authenticate a MAC address" (Claim 12)

Signify's Construction	Stingray's Construction
Governed by Pre-AIA 35 U.S.C. 112 Paragraph 6 **Function:** detecting intrusions into the wireless network by monitoring transmissions among said plurality of stations to detect failed attempts to authenticate MAC addresses; and generating an intrusion alert based upon detecting a number of failed attempts to authenticate a MAC address **Structure:** Indefinite for lack of corresponding structure.	Plain and ordinary meaning; this term is not subject to pre-AIA 35 U.S.C. 112 paragraph 6. Alternatively, if governed by Pre-AIA 35 U.S.C. 112 Paragraph 6: Function: detecting intrusions into the wireless network

100. I understand that Signify states that this term is a means-plus-function term in which the function is "detecting intrusions into the wireless network by monitoring transmissions among said plurality of stations to detect failed attempts to authenticate MAC addresses; and generating an intrusion alert based upon detecting a number of failed attempts to authenticate a MAC address." I further understand that Signify contends that the patent does not state a corresponding structure for the above-mentioned function. I also understand that Stingray states that the term should be accorded its plain and ordinary meaning and that the term is not a means-plus function term. Additionally, I understand that Stingray offers an alternative construction if the court finds that the claim is a means-plus-function term. In their alternative construction, Stingray agrees with Signify's construction requiring "detecting intrusions into the wireless network" but does not agree with the remainder of Signify's construction. Further, as of the time of this declaration, Stingray has not proposed any structure that would perform the claimed function. If Stingray later attempts

to propose a structure that it alleges performs the claimed function, I reserve the right to consider and respond to that proposal.

101. The basis for my opinions with respect to this term for the '678 Patent are substantially similar to the basis for my opinions for the term "a policing node for detecting intrusions into the MANET by monitoring transmissions among said plurality of nodes to detect contention-free mode operation outside of a CFP; and generating an intrusion alert based upon detecting contention-free mode operation outside a CFP" with respect to the '117 Patent.

102. As a preliminary matter, it is my opinion that the term is a means-plus-function term because the phrase "policing station" would not have been understood by a POSITA as having a well understood structural meaning and is not a term used in the art. Rather the term "policing station for" is simply a generic, or nonce term, that would have been understood by a POSITA as simply a substitute for the phrase "means for policing by"

103. Further, nothing in the claim or the specification of the '678 Patent clarifies or elaborates on the structure such that a POSITA would have understood "policing station" to convey sufficiently definite structure. The remained of the relevant portion of claim 12 simply discusses the function of a policing station. Moreover, rather than adding sufficiently definite structure, the specification makes it clear that the term is simply a generic description for software or hardware that performs a specified function. Specifically, the specification states:

> Turning now to FIG. 2, a first alternate embodiment of the wireless LAN/MAN 20 is now described. In this embodiment, the policing station 23 detects intrusions into the wireless network 20 by monitoring transmissions among the stations 21, 22 to detect failed attempts to authenticate MAC addresses. Upon detecting a certain predetermined number of failed attempts to authenticate a particular MAC address, the policing node 23 will generate an intrusion alert.

'678 Patent 6:45-52; *see also* Fig. 2, below (defining "Policing Node 23" purely in terms of the function it performs.

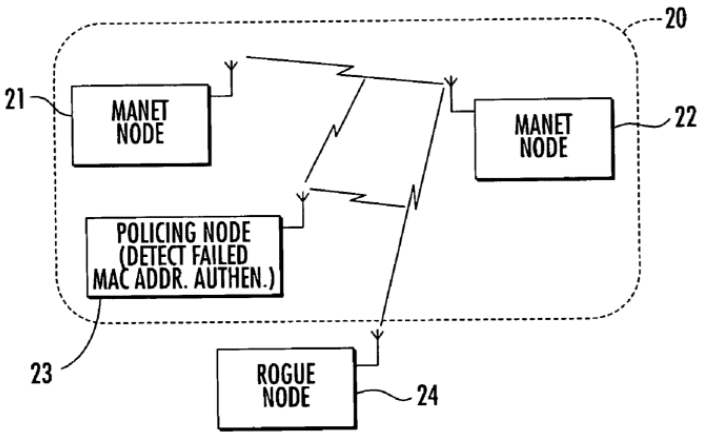


FIG. 2.

No particular hardware or software is ever enabled or described. Accordingly, because the term "policing station" is simply a generic term that fails to convey sufficiently definite structure, the above term is a means-plus-function term.

104. Further, I agree with Signify that the specification fails to identify any corresponding structure for the function of "detecting intrusions into the wireless network by monitoring transmissions among said plurality of stations to detect failed attempts to authenticate MAC addresses; and generating an intrusion alert based upon detecting a number of failed attempts to authenticate a MAC address."

105. For these and substantially similar reasons as those I have mentioned above with respect to the term "policing node . . . " it is my opinion that this term is a means-plus-function term.

106. I disagree with Stingray's proposed function for this term because it does not include the entire claimed function of the policing station means, but simply recites a short portion of that function. I understand that in a means-plus-function claim limitation, the identified structure must perform the entire claimed function and not just a portion of it.

2. "intrusion alert" (Claims 12 and 51)

Signify's Construction	Stingray's Construction
a notification generated and sent by the policing node(s) upon detecting an attempted intrusion	a notification indicating detection of an anomaly or abnormal event

107. Because this term is identical to the term I have provided my opinion on with respect to the '117 Patent and because the specifications of these patents are substantially identical, my opinion with respect to this term for the '678 Patent is the same as my opinion with respect to the '117 Patent.

G. The '572 Patent

1. "a cryptography circuit carried by said housing and connected to said MAC and said wireless transceiver for encrypting both address and data information for transmission by at least adding a plurality of encrypting bits to both the address and the data information, and for decrypting both the address and the data information upon reception" (Claim 1)

Signify's Construction	Stingray's Construction
Governed by Pre-AIA 35 U.S.C. 112 Paragraph 6 **Function:** encrypting both address and data information for transmission by at least adding a plurality of encrypting bits to both the address and the data information, and for decrypting both the address and the data information upon reception **Structure:** Indefinite for lack of corresponding structure. If not governed by 112 ¶ 6, the term "cryptography circuit" means "a circuit employing an algorithm and a cryptographic key and capable of encrypting and decrypting both address and data information for transmission"	Plain and ordinary meaning; this term is not subject to pre-AIA 35 U.S.C. 112 paragraph 6. Alternatively, if governed by Pre-AIA 35 U.S.C. 112 Paragraph 6: Function: encrypting both address and data information for transmission; and decrypting both the address and the data information upon reception

108. I understand that Signify states that this term is a means-plus-function term in which the function is "for encrypting both address and data information for transmission by at least adding a plurality of encrypting bits to both the address and the data information, and for decrypting both the address and the data information upon reception." I further understand that Signify contends that the patent does not state a corresponding structure for the above-mentioned function. I also understand that Stingray states that the term should be accorded its plain and ordinary meaning and that the term is not a means-plus function term. Additionally, I understand that Stingray offers an alternative construction if the court finds that the claim is a means-plus-function term. In their alternative construction, Stingray agrees with Signify's construction requiring "encrypting both address and data information for transmission; and decrypting both the address and the data information upon reception" but removes the language from Signify's construction and the claim itself, which states that encryption is done "by at least adding a plurality of encrypting bits to both the address and the data information." Further, as of the time of this declaration, Stingray has not proposed any structure that would perform the claimed function. If Stingray later attempts to propose a structure that it alleges performs the claimed function, I reserve the right to consider and respond to that proposal.

109. As a preliminary matter, it is my opinion that the term is a means-plus-function term because the phrase "cryptography circuit" would not have been understood by a POSITA as having a well understood structural meaning. Rather the term is simply a generic, or nonce term, that would have been understood by a POSITA as simply a substitute for the phrase a "means for." A POSITA would understand that a "circuit" is simply any interconnection of electrical elements for accomplishing a particular task, and the addition of the term "cryptography" does not provide any further structural limitations.

110. Further, nothing in the claim or the specification of the '572 Patent clarifies or elaborates on the structure such that a POSITA would have understood "cryptography circuit" to convey sufficiently definite structure for performing the claimed function. The remainder of the relevant portion of claim 1 simply discusses the function performed by the claimed cryptography circuit. Moreover, rather than adding sufficiently definite structure, the specification makes it clear that the term is simply a generic description for software or hardware that performs a specified function. Specifically, the specification states:

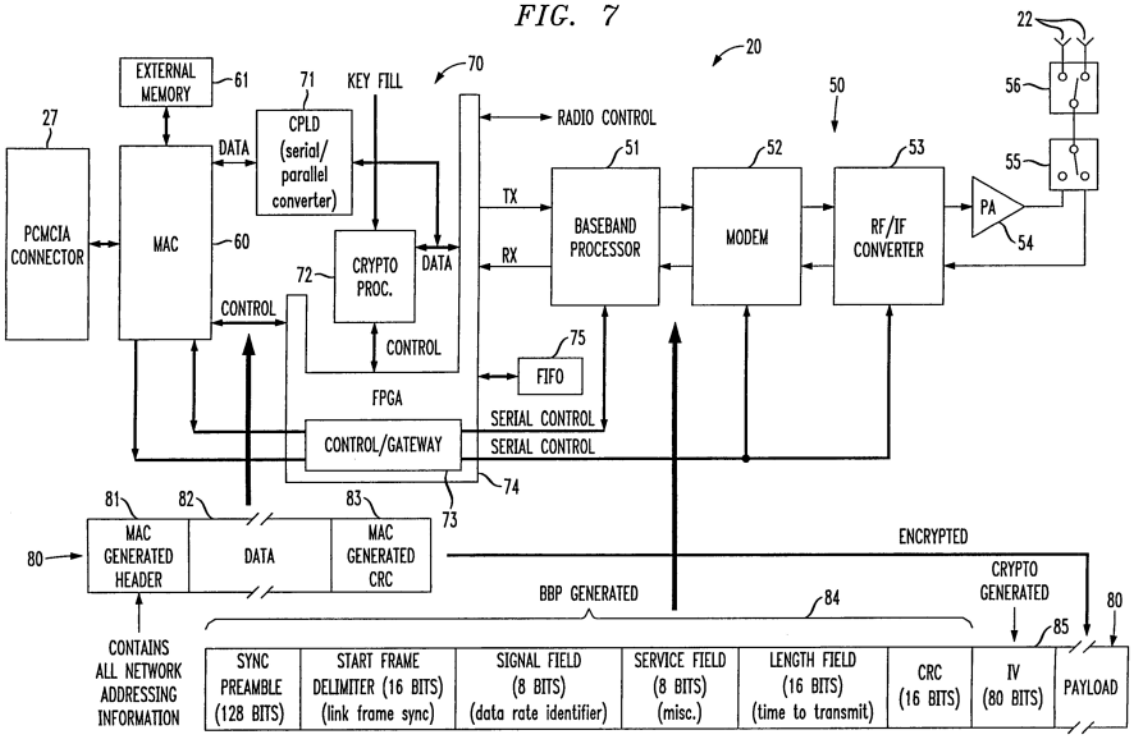
> The cryptography circuit may encrypt both address and data information for transmission, and decrypt both address and data information upon reception. Accordingly, a higher level of security may be provided by the encryption of the address and control portions of the transmitted packet contained within the MAC generated header. This information is not encrypted in conventional LAN cryptographic devices. The cryptography circuit may implement an algorithm and use a key to provide a predetermined security level, such as up to Type 1 security, although lower levels may also be implemented. Of course, the secure wireless LAN device may be used with other LAN devices, such as user stations and/or access points, in any of a number of different LAN configurations.

'572 Patent, 2:7-19. Indeed, the only structure identified at all for the cryptography circuit is a "cryptography processor 72" and "serial-to-parallel converter (CPLD) 71 connected to the MAC 60 and the cryptography processor":

> ***The cryptography circuit 70 also includes a cryptography processor 72 and serial-to-parallel converter (CPLD) 71 connected to the MAC 60 and the cryptography processor.*** A control and gateway block 73 is provided as part of the field programmable gate array (FPGA) 74. A FIFO 75 is also illustratively connected to the FPGA 74.

'572 Patent 5:20-25; see also Fig. 7 (illustrating cryptography circuit 70).

FIG. 7



The only structure at all that is disclosed for the cryptography circuit 70 is insufficient to perform the function of "encrypting both address and data information for transmission by at least adding a plurality of encrypting bits to both the address and the data information, and for decrypting both the address and the data information upon reception," and no further structure or algorithm for performing this function by this structure is provided elsewhere in the specification. Accordingly, because the term "cryptography circuit" is simply a generic term that fails to convey sufficiently definite structure or an algorithm for performing the claimed function, it is my opinion that the above term is a means-plus-function term.

111. I agree with Signify that the specification fails to identify any corresponding structure for the function of "for encrypting both address and data information for transmission by at least adding a plurality of encrypting bits to both the address and the data information, and for decrypting both the address and the data information upon reception."

112. I disagree with Stingray's proposed function for this term because it does not include the entire claimed function of the cryptography circuit means, but simply recites a short portion of that function. I understand that in a means-plus-function claim limitation, the identified structure must perform the entire claimed function and not just a portion of it.

113. In the alternative, if the Court does not find the term to be governed by pre-AIA 35 U.S.C. § 112 ¶ 6, I understand that Signify has proposed that "a cryptography circuit" means "a circuit employing an algorithm and a cryptographic key and capable of encrypting and decrypting both address and data information for transmission."

114. Signify's construction closely resembles the language in the specification of the patent and the asserted claim itself. The specification states:

> The cryptography circuit ***may encrypt both address and data information for transmission, and decrypt both address and data information upon reception. Accordingly, a higher level of security may be provided by the encryption of the address and control portions of the transmitted packet contained within the MAC generated header.*** This information is not encrypted in conventional LAN cryptographic devices***. The cryptography circuit may implement an algorithm and use a key*** to provide a predetermined security level, such as up to Type 1 security, although lower levels may also be implemented. Of course, the secure wireless LAN device may be used with other LAN devices, such as user stations and/or access points, in any of a number of different LAN configurations.

'572 Patent at 2:7-19. Accordingly, this describes the cryptography circuit as a circuit that encrypts and decrypts both address and data information using a cryptographic algorithm and a key, however, it does not provide any examples for how this is to be accomplished.

115. Therefore, it is my opinion that a POSITA would understand "a cryptography circuit" to be "a circuit employing an algorithm and cryptographic key and capable of encrypting and decrypting both address and data information for transmission."

2. "encrypting both address and data information" (Claim 1)

Signify's Construction	Stingray's Construction
reversibly encoding both MAC address and MAC data information to protect from reading without decryption	Plain and ordinary meaning

116. I understand that Signify has proposed that "encrypting both address and data information" means "reversibly encoding both MAC address and MAC data information to protect from reading without decryption." I also understand that Stingray states that no construction is necessary and that the term should be accorded its plain and ordinary meaning,

117. Signify's construction is supported by the language in the specification of the patent itself, which states that the cryptography circuit (which, as described previously and as specifically recounted in the claims, is connected to the MAC) encrypts both the address and the data information *of the MAC*, and contrasts it with conventional LAN devices that do not protect such information from being read without decryption:

> ***The cryptography circuit may encrypt both address and data information for transmission, and decrypt both address and data information upon reception.*** Accordingly, a higher level of security may be provided by the ***encryption of the address and control portions of the transmitted packet contained within the MAC generated header.*** This information is not encrypted in conventional LAN cryptographic devices.

'572 Patent at 2:7-13.

118. Further, both Signify's construction and the almost identical text in the specification are congruent with the way a POSITA would have understood the term. For example, *Microsoft Press Computer User's Dictionary* (1998) defines "encryption" as:

> the process of encoding data to prevent unauthorized access, especially during transmission. Encryption is usually based on a key that is essential for decoding. The U.S. National Bureau of Standards created a complex encryption standard (DES), which provides almost unlimited ways to encrypt documents.

SIGNIFYCC_00000021. Additionally, the *Encyclopedia of Technology Terms*, Que Publishing (2002) defines "encryption" as:

> the conversion of data into a form, called a ciphertext, that cannot be easily understood by unauthorized people. Decryption is the process of converting encrypted data back into its original form, so it can be understood.

SIGNIFYCC_00000031.

119. Therefore, it is my opinion that a POSITA would understand "encrypting both address and data information" to mean "reversibly encoding both MAC address and MAC data information to protect from reading without decryption."

3. "decrypting both the address and the data information" (Claim 1)

Signify's Construction	Stingray's Construction
recovering, upon reception, both the MAC address and the MAC data information that was encrypted	Plain and ordinary meaning

120. I understand that Signify has proposed that "decrypting both the address and the data information" means "recovering, upon reception, both the MAC address and the MAC data information that was encrypted." I also understand that Stingray states that no construction is necessary and that the term should be accorded its plain and ordinary meaning,

121. Signify's construction closely resembles the language in the specification of the patent itself, which states:

> The cryptography circuit may encrypt both address and data information for transmission, and decrypt both address and data information upon reception. Accordingly, a higher level of security may be provided by the encryption of the address and control portions of the transmitted packet contained within the MAC generated header. This information is not encrypted in conventional LAN cryptographic devices.

'572 Patent at 2:7-13.

122. Further, both Signify's construction and the almost identical text in the specification are congruent with the way a POSITA would have understood the term. For example, *Microsoft Press Computer User's Dictionary* (1998) defines "decryption" as:

> the process of restoring encrypted data to its original form

SIGNIFYCC_00000020. Additionally, the *Encyclopedia of Technology Terms*, Que Publishing (2002) defines "decryption" as:

> see encryption
>
> encryption: the conversion of data into a form, called a ciphertext, that cannot be easily understood by unauthorized people. Decryption is the process of converting encrypted data back into its original form, so it can be understood.

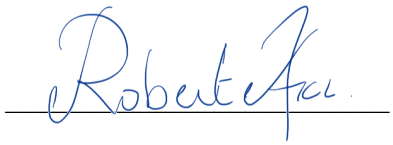
SIGNIFYCC_00000030- SIGNIFYCC_00000031.

123. Therefore, it is my opinion that a POSITA would understand "decrypting both the address and the data information" to be "recovering, upon reception, both the MAC address and the MAC data information that was encrypted."

VIII. CONCLUSION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on September 17, 2021 in Dallas, Texas.



Dr. Robert Akl, D.Sc.

Appendix A

Robert Akl, D.Sc.

Professional Summary

Dr. Akl has over 25 years of industry and academic experience. He is currently a Tenured Associate Professor at the University of North Texas and a Senior Member of IEEE. He has designed, implemented, and optimized both hardware and software aspects of several wireless communication systems for CDMA, Wi-Fi, and sensor networks. Dr. Akl has broad expertise in wireless communication, Bluetooth, CDMA/WCDMA network optimization, GSM, LTE, VoIP, telephony, computer architecture, and computer networks. He is a very active researcher and is well published and cited. He has been awarded many research grants by leading companies in the industry and the National Science Foundation. He has developed and taught over 100 courses in his field. Dr. Akl has received several awards and commendations for his work, including the 2008 IEEE Professionalism Award and was the winner of the 2010 Tech Titan of the Future Award.

Dr. Akl has extensive experience with patents in the wireless and networking industry. In the past ten years, he has worked as a technical expert in dozens of patent related matters, involving thousands of hours of research, investigation, and study. He has repeatedly been qualified as an expert by Courts, and has provided numerous technology tutorials to Courts, and given testimony by deposition and at trial. He has worked with companies large and small, both for and against the validity and infringement of patents, and has also helped counsel and Courts to understand technology that often seems complex. In doing so, he has become familiar with, and actively worked with, the legal principles that underlie patentability and validity and claim interpretation in the wireless and networking industries.

Areas of Expertise

2G, 3G, 4G, 5G, CDMA/WCDMA, GPS, GSM, UMTS, LTE, Ad-hoc Networks, Antenna Design, Bluetooth, Call Admission Control, Channel Coding, Communication Interfaces and Standards, Compression, Computer Architecture, MIMO Systems, Multi-cell Network Optimization, Network Security, Packet-networks, Telephony, VoIP, Wi-Fi, Wireless Communication, Wireless Sensors.

Education

Year	College/University	Degree	GPA
2000	Washington University in Saint Louis	D.Sc. in Electrical Engineering	**4.0 / 4.0**
1996	Washington University in Saint Louis	M.Sc. in Electrical Engineering	**4.0 / 4.0**
1994	Washington University in Saint Louis	B.Sc. in Electrical Engineering	**4.0 / 4.0**
1994	Washington University in Saint Louis	B.Sc. in Computer Science	**4.0 / 4.0**

Graduated *summa cum laude* and ranked first in undergraduate class.

Dissertation: "Cell Design to Maximize Capacity in Cellular Code Division Multiple Access (CDMA) Networks." Advisors: Dr. Manju Hegde and Dr. Paul Min.

Litigation Support and Expert Witness Experience

L1.	2021	**Alston & Bird LLP**
	Case:	Stingray IP Solutions v. Signify N.V., et al. Eastern district of Texas, Marshall division, Case No. 2:21-cv-00043-JRG; Case No. 2:21-cv-00044-JRG
	Matter:	Patent infringement, mobile ad-hoc networks
	Project:	Declaration to support claim construction
L2.	2021	**Cole Schotz P.C.**
	Case:	SkyBell Technologies, Inc. v. Vivint Smart Home, Inc., SimpliSafe, Inc., and Arlo Technologies Inc In the Matter of Certain IP Camera Systems Including Video Doorbells and Components Thereof, ITC Investigation No. 337-TA-1242
	Matter:	Patent infringement, wireless telecommunication systems
	Project:	Source code review, expert report infringement and domestic industry, rebuttal expert report, three-day deposition
L3.	2021	**Axinn, Veltrop & Harkrider LLP**
	Case:	Koninklijke Philips N.V. v. Thales DIS AIS USA, LLC et al. In the Matter of Certain UMTS and LTE Cellular Communication Modules and Products Containing the Same, ITC Investigation No. 337-TA-1240
	Matter:	Patent infringement, wireless communication systems
	Project:	Expert report regarding non-infringement and no domestic industry, deposition
L4.	2021	**Morgan, Lewis & Bockius LLP**
	Case:	SIPCO, LLC v. Aruba Networks, LLC and Hewlett Packard Enterprise Company District of Delaware, Case No. 1:20-cv-00537-MN
	Matter:	Patent infringement, wireless communication systems
	Project:	Declaration regarding claim construction
L5.	2021	**Ropes & Gray LLP**
	Case:	Palo Alto Networks Inc. v. Centripetal Networks, Inc. IPR2021-01150, IPR2021-01151, IPR2021-01155, IPR2021-01156, IPR2021-01270, PGR2021-00108, IPR2021-01520, IPR2021-01521
	Matter:	*Inter Partes* Review, network security systems
	Project:	Seven declarations to support 7 IPR petitions, declaration to support post grant review

L6.	2021	**Devlin Law Firm**
	Case:	CDN Innovations, LLC v. Grande Communications Networks, LLC Eastern district of Texas, Sherman division, Case No. 4:20-cv-653-SDJ
	Matter:	Patent infringement, telecommunication systems
	Project:	Declaration to support infringement contentions
L7.	2021	**Banner Witcoff**
	Case:	Sisvel International S.A., 3G Licensing S.A. v. ZTE (USA) Inc. et al. Northern district of Texas, Case No. 3:20-cv-01289-M
	Matter:	Patent infringement, wireless communication systems
	Project:	Declaration to support claim construction, deposition
L8.	2021	**Paul Hastings LLP**
	Case:	G. Holdings Ltd. v. Samsung Electronics Co., et al. Eastern district of Texas, Marshall division, Case No. 2:20-cv-00342-JRG
	Matter:	Patent infringement, electronic payment systems
	Project:	Declaration to support claim construction
L9.	2021	**Morgan, Lewis & Bockius LLP**
	Case:	Aruba Networks, LLC and Hewlett Packard Enterprise Company v. SIPCO, LLC IPR2021-00787
	Matter:	*Inter Partes* Review, wireless communication systems
	Project:	Declaration to support IPR petition
L10.	2021	**Jenner & Block LLP**
	Case:	Virentem Ventures LLC D/B/A Enounce v. TiVo Corp and Xperi Holding Corporation District of Delaware, Case No. 20-787-MN
	Matter:	Patent infringement, telecommunication systems
	Project:	Declaration to support claim construction
L11.	2021	**Carter Arnett**
	Case:	Correct Transmission LLC v. Adtran, Inc. and Juniper Networks, Inc. Western district of Texas, Waco division, Case No. 6:20-cv-669-ADA
	Matter:	Patent infringement, telecommunication systems
	Project:	Source code review, declaration to support claim construction
L12.	2021	**Fish & Richardson, P.C.**
	Case:	Quectel Wireless Solutions Co. Ltd. v. Koninklijke Philips N.V. IPR2021-00558, IPR2021-00559, IPR2021-00561
	Matter:	*Inter Partes* Review, wireless communication systems
	Project:	Three declarations to support 3 IPR petitions

L13.	2021	**Fish & Richardson, P.C.**
	Case:	Samsung Electronics Co. Ltd. v. Ericsson Inc. IPR2021-00447, IPR2021-00588, IPR2021-00613, IPR2021-00614, IPR2021-00643, IPR2021-00645, IPR2021-00684
	Matter:	*Inter Partes* Review, wireless communication systems
	Project:	Seven declarations to support 7 IPR petitions
L14.	2020	**Kilpatrick Townsend & Stockton LLP**
	Case:	GREE Inc. v. Supercell Oy Eastern district of Texas, Marshall division, Case No. 2:19-cv-00413-JRG-RSP
	Matter:	Patent infringement, mobile gaming
	Project:	Source code review, infringement expert report, supplemental expert report, validity expert report, deposition
L15.	2020	**Banner Witcoff**
	Case:	Sisvel International S.A., 3G Licensing S.A. v. ZTE (USA) Inc. et al. Northern district of Texas, Case No. 3:19-cv-01694-N
	Matter:	Patent infringement, wireless communication systems
	Project:	Declaration to support claim construction, deposition
L16.	2020	**Fish & Richardson, P.C.**
	Case:	Cellco Partnership D/B/A Verizon Wireless v. Huawei Technologies Co., Ltd IPR2020-01352, IPR202-01356, IPR2020-01357
	Matter:	*Inter Partes* Review, network communication systems
	Project:	Three declarations to support 3 Patent Owner responses
L17.	2020	**Kilpatrick Townsend & Stockton LLP**
	Case:	GREE Inc. v. Supercell Oy Eastern district of Texas, Marshall division, Case No. 2:20-cv-00113-JRG-RSP
	Matter:	Patent infringement, mobile gaming
	Project:	Source code review, declaration supporting claim construction, infringement expert report, validity expert report, supplemental report, deposition
L18.	2020	**Kilpatrick Townsend & Stockton LLP**
	Case:	GREE Inc. v. Supercell Oy Eastern district of Texas, Marshall division, Case No. 2:19-cv-00200-JRG-RSP, Case No. 2:19-cv-00237-JRG-RSP, Case No. 2:19-cv-00310-JRG-RSP; Case No. 2:19-cv-00311-JRG-RSP
	Matter:	Patent infringement, mobile gaming
	Project:	Source code review, four infringement expert reports, two supplemental infringement expert reports, four validity expert reports,

two supplemental expert reports, two second supplemental expert reports, 3-day deposition, jury trial testimony

L19. 2020 **Sheridan Ross P.C.**
Case: Justservice.net LLC v. Dropbox, Inc.
Western district of Texas, Waco division, Case No. 6:20-CV-00070-ADA
Matter: Patent infringement, computer systems and networking
Project: Source code review, declaration regarding claim construction

L20. 2020 **Perkins Coie LLP**
Case: Huizhou TCL Mobile Communication Co. Ltd., TCT Mobile (US) Inc., and TCL Mobile Communication (HK) Co., Ltd. v. Wi-LAN Inc.
Matter: *Ex Partes* Reexamination, QoS enhancements for wireless IP networks
Project: Declaration to support Requesters

L21. 2020 **Perkins Coie LLP**
Case: Intel Corporation v. UNM Rainforest Innovations
IPR2020-01576, IPR2020-01578, IPR2020-*to be assigned*
Matter: *Inter Partes* Review, wireless broadband
Project: Three declarations to support three IPR petitions

L22. 2020 **Calfee, Halter & Griswold LLP**
Case: Motorola Solutions, Inc. v. Hytera Communications Corp. Ltd. et al.
Northern district of Illinois, Case No. 1:17-cv-01972
Matter: Patent infringement, two-way radios
Project: Declaration regarding claim construction, deposition

L23. 2020 **Fish & Richardson, P.C.**
Case: Huawei Technologies Co., Ltd et al. v. Verizon Communications, Inc. et al.
Western district of Texas, Waco division, Case No. 6-20-cv-00090
Matter: Patent infringement, video communication
Project: Source code review, declaration regarding claim construction, infringement expert report, validity expert report, deposition

L24. 2020 **Kilpatrick Townsend & Stockton LLP**
Case: GREE Inc. v. Supercell Oy
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00070-JRG-RSP, Case No. 2:19-cv-00071-JRG-RSP
Matter: Patent infringement, mobile gaming
Project: Source code review, two infringement expert reports, two supplemental infringement expert reports, two second supplemental infringement expert reports, two rebuttal expert reports on validity,

two-day deposition, seven declarations supporting Gree's opposition to Supercell's motions for summary judgement, jury trial testimony

L25. 2020 **Cooley LLP**
Case: Saint Lawrence Communications, LLC v. Amazon.com, Inc., et al.
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00027-JRG
Matter: Patent infringement, AMR-WB, speech compression, coding and decoding
Project: Invalidity expert report

L26. 2020 **Prince Lobel Tye LLP**
Case: Intellectual Ventures I and II LLC v. VMware, Inc.
Western district of Texas, Austin division, Case No. 1:19-cv-01075-ADA
Matter: Patent infringement, networking systems
Project: Declaration to support claim construction

L27. 2020 **Faegre Baker Daniels LLP**
Case: CommScope, Inc. v. Rosenberger Technology, et al.
District of New Jersey, Case No. 19-cv-15962-MCA-LDW
Matter: Trade secret software, base station antenna design
Project: Declaration, deposition

L28. 2020 **Ropes & Gray LLP**
Case: Canon, Inc. v. TCL Electronics Holdings Ltd., et al.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-546-JRG
Matter: Patent infringement, communication interfaces
Project: Source code review, declaration to support claim construction, deposition

L29. 2019 **Perkins Coie LLP**
Case: Huizhou TCL Mobile Communication Co. Ltd., TCT Mobile (US) Inc., and TCL Mobile Communication (HK) Co., Ltd. v. Wi-LAN Inc.
IPR2020-00302, IPR2020-00303
Matter: *Inter Partes* Review, QoS enhancements for wireless IP networks
Project: Two declarations to support two IPR petitions

L30. 2019 **K & L Gates LLP**
Case: EVS CODEC Technologies, LLC and Saint Lawrence Communications, LLC v. ZTE Corporation, et al.
Northern district of Texas, Dallas division, Case No. 3:19-cv-00385-MBH
Matter: Patent infringement, EVS, speech compression, coding and decoding
Project: Invalidity expert report

L31.	2019	**Feinberg Day Alberti Lim & Belloli LLP**
	Case:	Uniloc 2017 LLC v. AT&T Mobility LLC, et al. Eastern district of Texas, Marshall division, Case No. 2:18-cv-00514-JRG
	Matter:	Patent infringement, wireless frequency bands and devices
	Project:	Two declarations to support claim construction, deposition
L32.	2019	**Ropes & Gray LLP**
	Case:	Huawei Technologies Co. Ltd. v. Harris Global Communications, Inc. IPR2019-01512, IPR2019-01631
	Matter:	*Inter Partes* Review, routing and security in wireless networks
	Project:	Two declarations to support two IPR petitions
L33.	2019	**Ropes & Gray LLP**
	Case:	Harris Corporation v. Huawei Device USA, Inc. et al. Eastern district of Texas, Marshall division, Case No. 2:18-cv-00439-JRG
	Matter:	Patent infringement, routing and security in wireless networks
	Project:	Declaration to support claim construction
L34.	2019	**Erise IP**
	Case:	Semcon IP Inc. v. ASUSTeK Computer Inc. Eastern district of Texas, Marshall division, Case No. 2:18-cv-00193-JRG
	Matter:	Patent infringement, adaptive power control
	Project:	Non-infringement expert report
L35.	2019	**Cooley LLP**
	Case:	Facebook Inc. v. BlackBerry Corp. et al. Northern District of California, Oakland division, Case No. 4:18-cv-05434-JSW
	Matter:	Patent infringement, mobile computing
	Project:	Declaration to support claim construction
L36.	2019	**Sidley Austin LLP**
	Case:	Semcon IP Inc. v. Amazon.com, Inc. Eastern district of Texas, Marshall division, Case No. 2:18-cv-00192-JRG
	Matter:	Patent infringement, adaptive power control
	Project:	Expert report regarding patent marking, rebuttal report regarding patent marking, deposition

L37.	2019	**Oblon, McClelland, Maier & Neustadt, LLP**
	Case:	MV3 Partners LLC v. Roku, Inc. Western district of Texas, Waco division, Case No. 6:18-cv-308-ADA
	Matter:	Patent infringement, mobile set top box
	Project:	Declaration to support claim construction, deposition, Markman hearing testimony
L38.	2019	**Banner & Witcoff, LTD.**
	Case:	Kathrein USA, Inc. v. Fractus S.A. IPR2019-00954, IPR2019-00955, IPR2019-00956, IPR2019-00957
	Matter:	*Inter Partes* Review, multiband antenna arrays
	Project:	Four declarations to support four IPR petitions
L39.	2019	**Fish & Richardson, P.C.**
	Case:	LG Electronics Inc. v. Saint Lawrence Communications LLC Southern district of New York, Case No. 1:18-cv-11082-DLC
	Matter:	Patent infringement, EVS, speech compression, coding and decoding
	Project:	Declaration relating to motion for summary judgment, expert report, deposition
L40.	2019	**Ropes & Gray LLP**
	Case:	SIPCO, LLC v. Emerson Electric Co. In the Matter of Certain Wireless Mesh Networking Products and Related Components Thereof, ITC Investigation No. 337-TA-1131
	Matter:	Patent infringement, links in wireless networks and remote monitoring
	Project:	Source code review, declaration to support claim construction, invalidity expert report, rebuttal expert report regarding non-infringement and no domestic industry
L41.	2019	**Fish & Richardson, P.C.**
	Case:	Maxell Ltd. v. Huawei Technologies Co. Ltd., ZTE, et al. Eastern district of Texas, Texarkana division, Case No. 5:18-cv-0033-RWS
	Matter:	Patent infringement, portable computing devices
	Project:	Declaration regarding claim construction
L42.	2019	**Ropes & Gray LLP**
	Case:	Emerson Electric Co. v. SIPCO, LLC IPR2019-00548, IPR2019-00549
	Matter:	*Inter Partes* Review, routing in wireless networks
	Project:	Two declarations to support two IPR petitions
L43.	2018	**Mishcon de Reya New York LLP**
	Case:	ChanBond, LLC v. Cox Communications, Inc. District of Delaware, Case No. 1:15-cv-00849-RGA
	Matter:	Patent infringement, wideband signal distribution system

	Project:	Validity expert report, deposition, sur-reply expert report, second sur-reply expert report, second deposition, jury trial with settlement mid-trial
L44.	2018	**Fish & Richardson, P.C.**
	Case:	In re: Qualcomm Antitrust Litigation (Client: Apple) Southern district of California, Case No. 3:17-cv-00108-GPC-MDD
	Matter:	Qualcomm antitrust litigation
	Project:	Two expert rebuttal reports, deposition
L45.	2018	**Susman Godfrey LLP**
	Case:	In re: Qualcomm Antitrust Litigation (Client: Class Action) Northern district of California, Case No. 5:17-md-02773-LHK
	Matter:	Qualcomm antitrust litigation
	Project:	Expert declaration on standard essential patents, expert report on deemed essential patents, rebuttal expert report, deposition
L46.	2018	**284 Partners**
	Case:	Federal Trade Commission. v. Qualcomm Incorporated Northern district of California, Case No. 5:17-cv-00220
	Matter:	Qualcomm antitrust litigation
	Project:	Expert report on standard essential patents, expert rebuttal report, deposition
L47.	2018	**Vorys, Sater, Seymour and Pease LLP**
	Case:	Route1 Inc. v. Airwatch LLC District of Delaware, Case No. 17-331-RGA
	Matter:	Patent infringement, remote access
	Project:	Source code review, declaration regarding claim construction, infringement expert report, validity expert report, reply expert report, deposition, three declarations regarding re-exam
L48.	2018	**Sidley Austin LLP**
	Case:	Samsung Electronics Co., Ltd v. Huawei Technologies Co., Ltd. IPR2017-01471, IPR2017-01474, IPR2017-01475
	Matter:	*Inter Partes* Review, 4G/LTE
	Project:	Three declarations to support three Patent Owner responses, supplemental declaration, deposition
L49.	2018	**Fitzpatrick Cella Harper & Scinto**
	Case:	IPC Systems, Inc. v. Cloud9 Technologies, LLC District of Delaware, Case No. 16-cv-443-GMS
	Matter:	Patent infringement, telephone stations and trading turrets
	Project:	Source code review, declaration regarding claim construction, supplemental declaration regarding claim construction

L50. 2018 **Haynes and Boone, LLP**
Case: LG Electronics Inc., et al. v. Wi-LAN Inc., et al.
IPR2018-00673, IPR2018-00674, IPR2018-00704, IPR2018-00705, IPR2018-00709, IPR2018-00710
Matter: *Inter Partes* Review, bandwidth allocation
Project: Six declarations to support six IPR petitions, two depositions, two reply declarations

L51. 2018 **Pillsbury Winthrop Shaw Pittman LLP**
Case: Cellular Communications Equipment v. ZTE, HTC Corporation, et al.
Eastern district of Texas, Case No. 6:16-cv-475-RWS
Matter: Patent infringement, LTE, power control, emergency notification
Project: Invalidity expert report, deposition

L52. 2018 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: FanDuel, Inc. DraftKings, Inc., and Bwin.Party Digital Entertainment PLC. v. CG Technology Development, LLC
IPR2017-00902, IPR2017-01333, IPR2017-01491, IPR2017-01532
Matter: *Inter Partes* Review, location-based gaming
Project: Four declarations to support four Patent Owner responses, two supplemental declarations, four depositions

L53. 2018 **Calfee, Halter & Griswold LLP**
Case: Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc.
Northern district of Ohio, Case No. 1:17-cv-01794-DNC
Matter: Patent infringement, two-way radios
Project: Source code review, declaration regarding claim construction, rebuttal declaration regarding claim construction, deposition, infringement expert report, validity expert report, two-day deposition

L54. 2017 **Covington & Burling LLP**
Case: Sharp Corporation, et al. v. Hisense Co., Ltd., et al.
In the Matter of Certain Wi-Fi Enabled Electronic Devices and Components Thereof, ITC Investigation No. 337-TA-1072
Matter: Patent infringement, Wi-Fi, OFDMA
Project: Declaration regarding claim construction

L55. 2017 **Vorys, Sater, Seymour and Pease LLP**
Case: Airwatch LLC and VMWare Inc. v. Route1 Inc.
IPR2017-02145
Matter: *Inter Partes* Review, remote access
Project: Declaration to support Patent Owner response

L56.	2017	**Simpson Thacher & Bartlett LLP**
	Case:	XR Communications, LLC. v. Ubiquiti Networks, Inc. Central district of California, Case No. 2:17-cv-02968-AG(JCGx)
	Matter:	Patent infringement, Wi-Fi and adaptive antennas
	Project:	Declaration regarding claim construction, deposition
L57.	2017	**Covington & Burling LLP**
	Case:	Huawei Device USA Inc. v. Hitachi Maxell, Ltd. IPR2018-00209, IPR2018-00210
	Matter:	*Inter Partes* Review, base station selection, GPS/Cellular location
	Project:	Two declarations to support two IPR petitions
L58.	2017	**Calfee, Halter & Griswold LLP**
	Case:	Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc. IPR2018-00128, IPR2017-02183
	Matter:	*Inter Partes* Review, two-way radios
	Project:	Declaration to support IPR petition, deposition, two supplemental declarations, two depositions
L59.	2017	**Finnegan Henderson Farabow Garrett & Dunner LLP**
	Case:	Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc. IPR2017-02179, IPR2017-02183
	Matter:	*Inter Partes* Review, two-way radios
	Project:	Two declarations to support two IPR petitions, deposition
L60.	2017	**Mayer Brown LLP**
	Case:	Silver Spring Networks, Inc. v. Sunrise Technologies, Inc. Silver Spring Networks, Inc. v. Weatherproof Wireless, LLC IPR2017-*To Be Assigned*, IPR2017-*To Be Assigned*
	Matter:	*Inter Partes* Review, power meter
	Project:	Two declarations to support two IPR petitions
L61.	2017	**Covington & Burling LLP**
	Case:	Hitachi Maxell, Ltd. v. Huawei Device USA Inc. et al. Eastern district of Texas, Texarkana division, Case No. 5:16-cv-00178-RWS
	Matter:	Patent infringement, 3G/4G
	Project:	Source code review, declaration regarding claim construction, invalidity expert report, non-infringement expert report, non-infringing alternatives expert report, two depositions
L62.	2017	**Finnegan Henderson Farabow Garrett & Dunner LLP**
	Case:	LG Electronics, Inc. et al. v. BLU Products, Inc. and CT Miami, LLC In the Matter of Certain LTE Wireless Communication Devices and Components Thereof, ITC Investigation No. 337-TA-1051
	Matter:	Patent infringement, 4G/LTE

	Project:	Declaration regarding claim construction, second declaration regarding claim construction
L63.	2017	**Sidley Austin LLP**
	Case:	Huawei Technologies Co., Ltd. v. Samsung Electronics Co., Ltd. IPR2017-01979, IPR2017-01980, IPR2017-01986
	Matter:	*Inter Partes* Review, 4G/LTE
	Project:	Three declarations to support three IPR petitions, deposition
L64.	2017	**Finnegan Henderson Farabow Garrett & Dunner LLP**
	Case:	Motorola Solutions, Inc. v. Hytera Communications Corp. Ltd. et al. In the Matter of Certain Two-way Radio Equipment Systems, Related Software and Components Thereof, ITC Investigation No. 337-TA-1053
	Matter:	Patent infringement, two-way radio
	Project:	Source code review, declaration regarding claim construction, invalidity expert report, non-infringement expert report, deposition, ITC hearing testimony
L65.	2017	**Haynes and Boone, LLP**
	Case:	Rackspace US, Inc. v. Realtime Data LLC IPR2017-01691
	Matter:	*Inter Partes* Review, data compression
	Project:	Declaration to support IPR petition
L66.	2017	**Pillsbury Winthrop Shaw Pittman LLP**
	Case:	ZTE (USA), HTC Corporation, et al. v. Cellular Communications Equipment IPR2017-01508, IPR2017-01509
	Matter:	*Inter Partes* Review, LTE, power control, emergency notification
	Project:	Two declarations to support two IPR petitions, two depositions
L67.	2017	**Alston & Bird LLP; Womble Carlyle Sandridge & Rice LLP**
	Case:	Itron, Inc. and Duke Energy Corp. v. Smart Meter Technologies IPR2017-01199
	Matter:	*Inter Partes* Review, power meter
	Project:	Declaration to support IPR petition, deposition
L68.	2017	**Haynes and Boone, LLP**
	Case:	Ericsson Inc. v. Regents of the University of Minnesota IPR2017-01186, IPR2017-01200, IPR2017-01213
	Matter:	*Inter Partes* Review, OFDM and MIMO
	Project:	Three declarations to support three IPR petitions

L69.	2017	**Quinn Emanuel Urquhart & Sullivan, LLP**
	Case:	GENBAND US, LLC v. Metaswitch Networks Ltd, et al. Eastern district of Texas, Marshall division, Case No. 2:16-cv-582-JRG-RSP
	Matter:	Patent infringement, Internet protocols and VoIP
	Project:	Expert report regarding essentiality
L70.	2017	**Mayer Brown LLP**
	Case:	Uniloc USA, Inc. et al. v. Avaya Inc., ShoreTel, Inc., et al. Eastern district of Texas, Tyler division, Case Nos. 6:15-cv-1168-JRG
	Matter:	Patent infringement, instant messaging and conference calling
	Project:	Source code review, non-infringement consulting
L71.	2017	**Fish & Richardson P.C.**
	Case:	Nokia Solutions and Networks US LLC, et al. v. Huawei Technologies Co. Ltd., et al. Eastern district of Texas, Marshall division, Case Nos. 2:16-cv-753-JRG-RSP, 2:16-cv-754
	Matter:	Patent infringement, 4G/LTE
	Project:	Claim construction, two declarations
L72.	2017	**Rothwell Figg Ernst & Manbeck, PC; Pepper Hamilton LLP**
	Case:	Samsung Electronics, et al. v. Rembrandt Wireless Technologies, LP IPR2015-00555
	Matter:	*Ex Parte* Reexamination, Bluetooth
	Project:	Two declarations to support two Patent Owner responses, supplemental declaration to support Patent Owner reply
L73.	2016	**Sidley Austin LLP**
	Case:	Huawei Technologies Co., et al. v. Samsung Electronics Co, et al. and Samsung Research America v. Hisilicon Technologies Co, LTD Northern district of California, San Francisco division, Case No. 3:16-cv-2787-WHO
	Matter:	Patent infringement, 3G/4G/LTE
	Project:	Source code review, declaration regarding claim construction, declaration opposing summary judgement, infringement expert report, invalidity expert report, non-infringement expert report, validity expert report, two depositions
L74.	2016	**Bragalone Conroy PC**
	Case:	Securus Technologies, Inc. v. Global Tel*Link Corporation CBM2017-00034
	Matter:	Covered Business Method Review, call monitoring and recording
	Project:	Declaration to support CBM petition, deposition

L75. 2016 **Braxton, Hilton & Perrone PLLC**
Case: Biosonix, LLC. v. Hydrowave, LLC et al.
Eastern district of Texas, Case No. 2:16-cv-139-RC
Matter: Patent infringement, underwater transceivers
Project: Claim construction, Markman hearing testimony

L76. 2016 **Gray Reed & McGraw**
Case: Optis Cellular Technology, LLC and PanOptis Patent Management, LLC. v. Blackberry Corporation, et al.
Eastern district of Texas, Marshall division, Case No. 2:16-cv-59-JRG-RSP, Case No. 2:16-cv-61-JRG-RSP, Case No. 2:16-cv-62-JRG-RSP
Matter: Patent infringement, LTE
Project: Claim construction, three declarations regarding claim construction, deposition

L77. 2016 **Ropes & Gray LLP; Davidson Berquist Jackson & Gowdey**
Case: SIPCO, LLC et al v. Emerson Electric Co. et al
Eastern district of Texas, Tyler division, Case No. 6:15-cv-907
Emerson Electric Co. et al v. SIPCO, LLC et al.
Northern district of Georgia, Atlanta division, Case No. 1:15-cv-00319-AT
Matter: Patent infringement, links in wireless networks and remote monitoring
Project: Source code review, invalidity consulting

L78. 2016 **EIP US LLP**
Case: GENBAND US, LLC et al. v. Metaswitch Networks Ltd
IPR2015-01456, IPR2015-01457
Matter: *Inter Partes* Review, media gateways
Project: Two declarations to support Patent Owner responses, two depositions

L79. 2016 **Haynes and Boone, LLP**
Case: Cox Communications, Inc. v. AT&T Intellectual Property I, II, LP
IPR2015-01187, IPR2015-01227, IPR2015-01273, IPR2015-01536
Matter: *Inter Partes* Review, cable networks
Project: Four declarations to support Patent Owner responses, four depositions

L80. 2016 **Mayer Brown LLP**
Case: Odyssey Wireless v. Motorola Mobility LLC
Eastern district of North Carolina, Western division, Case No. 5:14-cv-491-D
Southern district of California, Case No. 3:15-cv-01741-H-RBB
Matter: Patent infringement, LTE
Project: Source code review, non-infringement consulting

L81. 2016 **Cooley LLP; Finnegan LLP**
Case: Saint Lawrence Comm. LLC v. Motorola Mobility LLC, ZTE (USA) Inc., et al.
Eastern district of Texas, Marshall division, Case No. 2:15-cv-000351-JRG, Case No. 2:15-cv-000349-JRG
Matter: Patent infringement, speech compression, coding and decoding
Project: Invalidity expert report, expert report regarding AMR-WB standard, expert report regarding Opus and Silk, supplemental expert report regarding invalidity, two-day depositions, jury trial testimony for Motorola

L82. 2015 **Sidley Austin LLP**
Case: Evolved Wireless, LLC v. Microsoft Corp, et al.
District of Delaware, Case No. 15-cv-546
Matter: Patent infringement, LTE
Project: Prior art and invalidity consulting

L83. 2015 **McKool Smith**
Case: Optis Wireless Technology, LLC and PanOptis Patent Management, LLC. v. ZTE Corporation and ZTE (USA) Inc.
Eastern district of Texas, Marshall division, Case No. 2:15-cv-300-JRG-RSP
Matter: Patent infringement, cellular messages and multimedia attachments
Project: Source code review, claim construction, declaration

L84. 2015 **Fish & Richardson, P.C.**
Case: Saint Lawrence Comm. LLC v. LG Elec., Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:14-cv-1055-JRG
Matter: Patent infringement, speech compression, coding and decoding
Project: Invalidity expert report

L85. 2015 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: LG Electronics, Inc. v. Cellular Communications Equipment LLC IPR2016-00178
Matter: *Inter Partes* Review, LTE
Project: Declaration to support IPR petition

L86. 2015 **McKool Smith**
Case: AT&T, et al. v. Cox Communication, Inc., et al.
District of Delaware, Case No. 14-1106-GMS
Matter: Patent infringement, cable networks
Project: Claim construction, declaration

L87.	2015	**McKool Smith**
	Case:	Ericsson Inc., et al. v. TCL Communication, et al. Eastern district of Texas, Marshall division, Case No. 2:15-cv-00011-RSP
	Matter:	Patent infringement, wireless devices and systems
	Project:	Source code review, claim construction, declaration, infringement expert report, validity expert report, two-day depositions
L88.	2015	**Foley & Lardner LLP**
	Case:	Kyocera Communications, Inc. v. Cellular Communications Equipment LLC IPR2015-01559, IPR2015-01564
	Matter:	*Inter Partes* Review, LTE, power control, emergency notification
	Project:	Two declarations to support two IPR petitions
L89.	2015	**Fish & Richardson, P.C.**
	Case:	Fairfield Industries Inc. v. Wireless Seismic, Inc. Southern district of Texas, Case No. 4:14-cv-02972-KPE
	Matter:	Patent infringement, wireless sensor networks
	Project:	Non-infringement expert report
L90.	2015	**Quinn Emanuel Urquhart & Sullivan, LLP**
	Case:	GENBAND US, LLC v. Metaswitch Networks Ltd, et al. Eastern district of Texas, Marshall division, Case No. 2:14-cv-33-JRG-RSP
	Matter:	Patent infringement, Internet protocols and VoIP
	Project:	Expert report regarding essentiality, non-infringement expert report, rebuttal expert report regarding non-practice, supplemental rebuttal expert report, three-day depositions, jury trial testimony
L91.	2015	**Duane Morris LLP; Foley & Lardner LLP**
	Case:	Mobile Telecommunications Technologies, LLC v. Leap Wireless International, Cricket Communications, Inc. Eastern district of Texas, Marshall division, Case No. 2:13-cv-00885-RSP
	Matter:	Patent infringement, OFDM and MIMO
	Project:	Non-infringement expert report, deposition
L92.	2015	**Hogan Lovells US LLP; Kenyon & Kenyon LLP**
	Case:	One-E-Way v. Beats Electronics, LLC, Sony Corporation, et al. In the Matter of Certain Wireless Headsets, ITC Investigation No. 337-TA-943
	Matter:	Patent infringement, wireless communication
	Project:	Claim construction, declaration

L93.	2015	**McKool Smith**
	Case:	Solocron Media, LLC v. AT&T Inc., et al. Eastern district of Texas, Marshall division, Case No. 2:13-cv-1059-JRG
	Matter:	Patent infringement, ringtone download
	Project:	Claim construction, invalidity expert report
L94.	2015	**EIP US LLP**
	Case:	Good Technology Software, Inc. v. Mobile Iron, Inc. IPR2015-00833, IPR2015-00836, IPR2015-01090
	Matter:	*Inter Partes* Review, software management in wireless devices
	Project:	Three declarations to support three IPR petitions
L95.	2015	**McKool Smith**
	Case:	AirWatch LLC v. Good Technology Corp Northern district of Georgia, Case No. 1:14-cv-02281-SCJ
	Matter:	Patent infringement, software management in wireless devices
	Project:	Claim construction, declaration
L96.	2015	**Simpson Thacher & Bartlett LLP**
	Case:	IXI Mobile (R&D) Ltd. et al. v. Apple Inc. Southern district of New York, Case No. 14-cv-7594-RJS
	Matter:	Patent infringement, PDA and Bluetooth
	Project:	Invalidity consulting
L97.	2014	**Bragalone Conroy PC**
	Case:	Global Tel*Link Corporation v. Securus Technologies, Inc. IPR2014-00785, IPR2014-00810, IPR2014-00824, IPR2014-00825, IPR2014-01278, IPR2014-01282, IPR2014-01283
	Matter:	*Inter Partes* Review, VoIP call monitoring and recording, allocating telecommunication resources and information systems
	Project:	Seven declarations to support seven Patent Owner responses, five depositions
L98.	2014	**Orrick, Herrington & Sutcliffe LLP**
	Case:	Shopkick, Inc. v. Novitaz, Inc. IPR2015-00277, IPR2015-00278
	Matter:	*Inter Partes* Review, wireless customer service management
	Project:	Two declarations to support two IPR petitions
L99.	2014	**Paul Hastings LLP**
	Case:	Cellular Communications Equipment LLC v. AT&T, et al. Eastern district of Texas, Tyler division, Case No. 6:13-cv-507-LED (Lead Case for Consolidation)
	Matter:	Patent infringement, 3G cellular communication
	Project:	Claim construction, declaration

L100. 2014 **Baker Botts LLP**
Case: Orlando Communications LLC v. AT&T, et al.
M.D. Florida, Case No. 6:14-cv-01021
Matter: Patent infringement, 3G/4G cellular communication
Project: Non-infringement and claim construction consulting

L101. 2014 **EIP US LLP**
Case: Good Technology Software, Inc. v. AirWatch, LLC
IPR2015-00248, IPR2015-00875
Matter: *Inter Partes* Review, software management in wireless devices
Project: Two declarations to support two IPR petitions

L102. 2014 **Bragalone Conroy PC**
Case: Securus Technologies, Inc. v. Global Tel*Link Corporation
IPR2015-00153, IPR2015-00155, IPR2015-00156
Matter: *Inter Partes* Review, VoIP call monitoring and recording
Project: Three declarations to support three IPR petitions, two depositions

L103. 2014 **Andrews Kurth LLP**
Case: Sony Mobile Communications (USA) v. Adaptix Inc.
IPR2014-01524, IPR2014-01525
Matter: *Inter Partes* Review, subcarrier selection in LTE
Project: Two declarations to support two IPR petitions, deposition

L104. 2014 **Steptoe & Johnson LLP; Baker & McKenzie LLP**
Case: VTech Communications, Inc. and Uniden America Corporations v. Spherix Incorporated
IPR2014-01432
Matter: *Inter Partes* Review, IP telephony
Project: Declaration to support IPR petition, deposition, reply declaration, deposition

L105. 2014 **Steptoe & Johnson LLP; Baker & McKenzie LLP**
Case: Spherix Inc. v. VTech Telecommunications Ltd., et al.
Spherix Inc. v. Uniden Corp, et al.
Northern district of Texas, Dallas Division, Case No. 3:13-cv-3494 and 3:13-cv-3496
Matter: Patent infringement, IP telephony
Project: Claim construction, declaration, deposition

L106. 2014 **McKool Smith**
Case: Good Technology Corp. v. MobileIron, Inc.
Northern district of California, Case No. 5:12-cv-05826-PSG
Matter: Patent infringement, software management in wireless devices

Project: Claim construction, three declarations, claim invalidity expert report, non-infringement expert report, deposition, jury trial testimony

L107. 2014 **Lee & Hayes**
Case: Broadcom Corp. v. Ericsson, Inc.
IPR2013-00601, IPR2013-00602, and IPR2013-00636
Matter: *Inter Partes* Review, ARQ protocols
Project: Three declarations to support Patent Owner responses, two declarations to support Patent Owner Motion to Amend, deposition, two reply declarations

L108. 2014 **Sidley Austin LLP**
Case: Adaptix, Inc. v. Huawei Technologies Co., et al.
Eastern district of Texas, Case No. 6:13-cv-00438, 439, 440 and 441
Matter: Patent infringement, subcarrier selection in LTE
Project: Source code review, non-infringement consulting

L109. 2014 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Cell and Network Selection LLC v. Huawei Technologies Co., et al.
Eastern district of Texas, Case No. 6:13-cv-00404-LED-JDL
Matter: Patent infringement, base station selection in LTE
Project: Non-infringement consulting

L110. 2014 **Feinberg Day Alberti & Thompson LLP**
Case: DSS Technology Management, Inc. v. Apple Inc.
Eastern district of Texas, Tyler division, Case No. 6:13-cv-00919-JDL
Matter: Patent infringement, PDA and Bluetooth
Project: Claim construction and invalidity consulting

L111. 2014 **Sheppard Mullin Richter & Hampton LLP**
Case: Digcom Inc. v. ZTE (USA), Inc.
District of Nevada, Case No. 3:13-cv-00178-RCJ-WGC
Matter: Patent infringement, cellular communication
Project: Claim construction consulting

L112. 2014 **Lott & Fischer**
Case: Zenith Electronics, LLC, et al. v. Craig Electronics, Inc.
Southern district of Florida, Case No. 9:13-cv-80567-DMM/DLB
Matter: Patent infringement, HDTV transmission and reception
Project: Opening expert report regarding nonessentiality

L113. 2013 **McKool Smith**
Case: Zenith Electronics, LLC, et al. v. Curtis International Ltd.
Southern district of Florida, Case No. 9:13-cv-80568-DMM/DLB
Matter: Patent infringement, HDTV transmission and reception
Project: Claim construction, declaration, deposition

L114. 2013 **Gibson Dunn**
Case: Straight Path IP Group v. Sharp Corp. and Sharp Electronics Corp.
In the Matter of Certain Point-to-Point Network Communication Devices and Products Containing Same, ITC Investigation No. 337-TA-892
Matter: Patent infringement, point-to-point network communication
Project: Non-infringement consulting

L115. 2013 **Kilpatrick Townsend & Stockton LLP; Cooley LLP**
Case: Monec Holding AG v. Motorola Mobility LLC, HTC, et al.
District of Delaware, Case No. 1:11-cv-798-LPS-SRF
Matter: Patent infringement, displaying books on tablets
Project: Non-infringement expert report for Motorola, non-infringement expert report for HTC, deposition

L116. 2013 **Gartman Law Group**
Case: Lone Star WiFi LLC v. Legacy Stonebriar Hotel, Ltd; et al.
Eastern district Of Texas, Tyler, Case No. 6:12-cv-957
Matter: Patent infringement, levels of access in Wi-Fi networks
Project: Claim validity consulting

L117. 2013 **White & Case, LLP**
Case: Nokia Corp and Nokia, Inc. v. HTC Corp and HTC America, Inc.
In the Matter of Certain Portable Electronic Communication Devices, Including Mobile Phones and Components Thereof, ITC Investigation No. 337-TA-885
Matter: Patent infringement, App download and installation
Project: Non-infringement consulting

L118. 2013 **Heim, Payne & Chorush, LLP**
Case: Rembrandt Wireless v. Samsung Electronics Co., et al.
Eastern district of Texas, Marshall, Case No. 2:13-cv-213-JRG-RSP
Matter: Patent infringement, Bluetooth
Project: Expert report regarding validity, deposition, jury trial

L119. 2013 **Baker Hostetler; Davis Polk & Wardwell LLP**
Case: Comcast v. Sprint; and Nextel Inc.
Eastern district of Pennsylvania, Case No. 2:12-cv-00859-JD
Matter: Patent infringement, SMS/MMS in Cellular Networks
Project: Infringement expert report, validity expert report, reply expert report, declaration, two-day depositions, jury trial testimony

L120. 2013 **McKool Smith**
Case: Samsung Electronics America v. Ericsson Inc.
In the Matter of Certain Wireless Communications Equipment and Articles Therein, ITC Investigation No. 337-TA-866
Matter: Patent infringement, LTE uplink and downlink
Project: Source code review, prior art research, claim construction, claim invalidity expert report, non-infringement expert report, ITC hearing testimony

L121. 2012 **DLA Piper US LLP**
Case: CSR Technology Inc. v. Freescale Semiconductor, Inc.
USDC-San Francisco, Case No. 3:12-cv-02619-RS
Matter: Patent infringement, radio transceivers
Project: Claim construction, declaration

L122. 2012 **Fish & Richardson P.C.**
Case: GPNE Corp. v. Apple, Inc.; et al.
USDC-ND California, Case No. 5:12-cv-02885-LHK
Matter: Patent infringement, resource allocation in wireless networks
Project: Prior art research consulting

L123. 2012 **Polsinelli Shughart PC**
Case: Single Touch Interactive, Inc. v. Zoove Corporation
Northern district of California, Case No. 3:12-cv-00831-JSC
Matter: Patent infringement, abbreviated dialing, information delivery
Project: Claim construction, Markman hearing testimony, two declarations

L124. 2012 **K & L Gates**
Case: EON Corp. IP Holdings, LLC v. Novatel Wireless, Inc.; et al.
DC-Tyler, Texas, Case No. 6:11-cv-00015-LED-JDL
Matter: Patent infringement, wireless modem and 3G services
Project: Non-infringement expert report, deposition

L125. 2012 **Simpson Thacher & Bartlett LLP**
Case: CSR Technology, Inc. v. Bandspeed, Inc.
Western district of Texas, Case No. 1:12-cv-297-LY
Matter: Patent infringement, packet identification in 2.4 GHz and 5 GHz
Project: Source code review, Markman hearing testimony, infringement expert report

L126. 2012 **Sheppard Mullin Richter & Hampton LLP**
Case: Wi-LAN v. HTC America, Inc., et al.
Eastern district of Texas, Case No. 6:10-cv-521-LED
Matter: Patent infringement, CDMA, Orthogonal Codes
Project: Source code review, non-infringement expert report, deposition, jury trial testimony

L127. 2012 **Dechert LLP**
Case: Hitachi v. TPV and Vizio, Inc.; and Vizio v. Hitachi, LTD.
Eastern district of Texas, Case No. 2:10-cv-260
Matter: Patent infringement, HD television transmission and reception
Project: Prior art research, claim invalidity consulting

L128. 2012 **Fish & Richardson P.C.; Covington & Burling; Alston & Bird; Brinks Hofer Gilson & Lione**
Case: InterDigital Commc'n, LLC v. Huawei Tech. Co. LTD; LG Electronics, Inc.; Nokia, Inc.; and ZTE (USA) Inc.
Certain Wireless Devices With 3G Capabilities and Components Thereof, ITC Investigation No. 337-TA-800
Matter: Patent infringement, channel coding in UMTS, HSDPA
Project: Non-infringement consulting

L129. 2012 **Fish & Richardson P.C.; Covington & Burling; Alston & Bird; Brinks Hofer Gilson & Lione**
Case: InterDigital Commc'n, LLC v. Huawei Tech. Co. LTD; LG Electronics, Inc.; Nokia, Inc.; and ZTE (USA) Inc.
District of Delaware, Case No. 1:11-cv-00654-UNA
Matter: Patent infringement, channel coding in UMTS, HSDPA
Project: Non-infringement consulting

L130. 2011 **O'Melveny & Myers LLP**
Case: MobileMedia Ideas, LLC v. Apple, Inc.
District of Delaware, Case No. 1:10-cv-00258-SLR-MPT
Matter: Patent infringement, voice control, call rejection in mobile phones
Project: Source code review, prior art research, declaration, claim invalidity expert report, non-infringement expert report, deposition, jury trial testimony

L131. 2011 **Wilmer Cutler Pickering Hale and Dorr**
Case: Apple, Inc. v. Samsung Electronics Co.
Northern district of California, Case No. 5:11-cv-01846-LHK
Matter: Patent infringement, channel coding in CDMA, E-AGCH, TFCI
Project: Prior art research, claim construction consulting

L132. 2011 **Weil, Gotshal & Manges LLP**
Case: Vizio, Inc. v. Renesas Electronics America, Inc.
ITC Investigation No. 337-TA-789
Matter: Patent infringement, HD television transmission and reception
Project: Claim invalidity consulting

L133.	2011	**Shapiro Cohen**
	Case:	TenXc Wireless Inc. v. Andrew LLC TenXc Wireless Inc. v. Mobi Antenna Technologies Ltd.
	Matter:	Patent infringement, antenna design, sectorized cellular network
	Project:	Claim validity consulting
L134.	2010	**Fish & Richardson P.C.**
	Case:	Vizio, Inc., v. LG Electronics, Inc. ITC Investigation No. 337-TA-733
	Matter:	Patent infringement, HD television transmission and reception
	Project:	Claim charts, claim construction expert report, deposition
L135.	2010	**Fish & Richardson P.C.**
	Case:	Vizio, Inc., v. LG Electronics, Inc. District of Maryland, Case No. 1:09-cv-1481-BEL
	Matter:	Patent infringement, HD television transmission and reception
	Project:	Claim charts, claim construction expert report, deposition
L136.	2008	**Kaye Scholer LLP**
	Case:	eBay Inc. v. IDT. Western district of Arkansas, Case No. 4:08-cv-4015-HFB
	Matter:	Patent infringement, long distance communication using Internet
	Project:	Prior art research, claim construction consulting
L137.	2008	**Simpson Thacher & Bartlett LLP**
	Case:	Commil USA, LLC v. Cisco Systems, Inc. Eastern district of Texas, Case No. 2:07-cv-00341-DF-CE
	Matter:	Patent infringement, two-level wireless protocol
	Project:	Prior art research
L138.	2006	**Woodfill and Pressler**
	Case:	Charles Russell v. Interinsurance Exchange of the Auto Club Harris County, Texas, Case No. 2005-19706
	Matter:	House fire and insurance claim
	Project:	Determining user location using cellular phone records, expert report, deposition, jury trial testimony

Consulting History

From:	1/2013	**Heim, Payne & Chorush, LLP**
To:	3/2013	Houston, TX
	Duties:	Analyze patents on wireless technologies.

From: 4/2007 **Collin County Sheriff's Office**
To: 5/2007 McKinney, TX
Duties: Analyzed cellular record data and determined user location in a double-homicide investigation.

From: 4/2004 **Allegiant Integrated Solutions**
To: 5/2004 Fort Worth, TX
Duties: Designed and developed an integrated set of tools for fast deployment of wireless networks. The tools optimize the placement of Access Points and determine their respective channel allocations to minimize interference and maximize capacity.

From: 3/2002 **Input/Output Incorporated**
To: 4/2002 New Orleans, LA
Duties: Designed and implemented an algorithm in MATLAB for optimizing the frequency selection process used by sonar for scanning the bottom of the ocean.

From: 6/1998 **Teleware Corporation**
To: 7/1998 Seoul, South Korea
Duties: Designed and developed a software package for analyzing the capacity in a CDMA network to maximize the number of subscribers.

Employment History

From: 1/2015 **University of North Texas**
To: Present Denton, TX
Position: *Associate Chair of Graduate Studies Department of Computer Science and Engineering*
In charge of all administrative duties related to the Master's and Ph.D. programs in the department.

From: 5/2008 **University of North Texas**
To: Present Denton, TX
Position: *Tenured Associate Professor Department of Computer Science and Engineering*
Conducting research on cellular networks and wireless sensor networks. Teaching wireless communication courses. Advising graduate and undergraduate students.

From: 9/2002 **University of North Texas**
To: 5/2008 Denton, TX
Position: *Assistant Professor Department of Computer Science and Engineering*
Conducting research on WCDMA/UMTS wireless networks. Teaching wireless communication and computer architecture courses. Advising graduate and undergraduate students.

From: 1/2002 **University of New Orleans**
To: 8/2002 New Orleans, LA
Position: *Assistant Professor Department of Electrical Engineering*
Designed and taught two new courses "Computer Systems Design I and II". Developed a Computer Engineering Curriculum with strong hardware-design emphasis. Formed a wireless research group. Advised graduate and undergraduate students.

From: 10/2000 **Comspace Corporation**
To: 12/2001 Coppell, TX
Position: *Senior Systems Engineer*
Designed, coded (in Matlab), and simulated Viterbi decoding, Turbo coding, trellis coded modulation (TCM), and Reed-Muller codes. Optimized soft decision parameters and interleavers for additive white Gaussian and Rayleigh faded channels. Extended the control and trunking of push-to-talk Logic Trunked Radio (LTR) to include one-to-one and one-to-many voice and data messaging.

From: 8/1996 **MinMax Corporation**
To: 8/2000 Saint Louis, MO
Position: *Research Associate*
Designed software packages that provide the tools to flexibly allocate capacity in a CDMA network and maximize the number of subscribers. Analyzed and simulated different audio compression schemes. Validated, simulated (logical and timing), and developed the hardware architecture for an ATM switch capable of channel group switching.

From: 8/1994 **Washington University**
To: 8/2000 Saint Louis, MO
Position: *Research and Teaching Assistant*
Taught, consulted, and graded Circuit Analysis at the undergraduate level and Network Design at the graduate level.

Publications

Conference Proceedings

C1. U.K. Dey, **R. Akl**, R. Chataut, M. Robaei, "Modified PHY Layer for High Performance V2X Communication using 5G NR," *IEEE UEMCON 11th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, October 2020, paper no. 1570681534, 6 pgs.

C2. R. Chataut, **R. Akl**, "An Efficient and Fair Scheduling for Downlink 5G Massive MIMO Systems," *IEEE Texas Symposium on Wireless and Microwave Circuits and Systems*, June 2020, paper no.TSWMCS2020-39, 8 pgs.

C3. R. Chataut, **R. Akl**, "Efficient and Low-Complexity Iterative Detectors for 5G Massive MIMO Systems," *IEEE DCOSS 2020 International Conference on Distributed Computing in Sensor Systems*, May 2020, pp. 442-449, 8 pgs.

C4. U.K. Dey, **R. Akl**, R. Chataut, "High Throughput Vehicular Communication Using Spatial Multiplexing MIMO," *IEEE CCWC 2020 The 10th Annual Computing and Communication Workshop and Conference*, January 2020, paper no. 1570613408, 6 pgs.

C5. R. Chataut, **R. Akl**, M. Robaei, "Accelerated and Preconditioned Refinement of Gauss-Seidel Method for Uplink Signal Detection in 5G Massive MIMO Systems," *IEEE CCWC 2020 The 10th Annual Computing and Communication Workshop and Conference*, January 2020, paper no. 1570605343, 7 pgs.

C6. M. Robaei, **R. Akl**, "Examining Spatial Consistency for Millimeter-Wave Massive MIMO Channel Estimation in 5G-NR," *IEEE ICCE 2020 The 38th International Conference on Consumer Electronics*, January 2020, paper no. 1570596880, 6 pages.

C7. R. Chataut, **R. Akl**, "Channel Gain Based User Scheduling for 5G Massive MIMO Systems," *IEEE HONET-ICT 2019 The 16th International Conference on Smart Cities: Improving Quality of Life Using ICT & IoT and AI*, October 2019, paper no. 1570565594, 5 pgs.

C8. M. Robaei, **R. Akl**, "Time-Variant Broadband mmWave Channel Estimation Based on Compressed Sensing," *IEEE UEMCON 2019 The 10th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, October 2019, paper no. 1570577430, 7 pages.

C9. R. Chataut, **R. Akl**, U. Dey, "Least Square Regressor Selection Based Detection for Uplink 5G Massive MIMO Systems," *IEEE WAMICON 2019 The 20th Annual IEEE Wireless and Microwave Technology Conference*, April 2019, paper no. 1570524727, 6 pgs.

C10. R. Chataut, **R. Akl**, "Huber Fitting Based ADMM Detection for Uplink 5G Massive MIMO Systems," *IEEE UEMCON 2018 The 9th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, November 2018, paper no. 1570492416, 5 pgs.

C11. R. Chataut, **R. Akl**, "Efficient and Low Complex Uplink Detection for 5G Massive MIMO Systems," *IEEE WAMICON 2018 The 19th Annual Wireless and Microwave Technology Conference*, April 2018, paper no. 1570431593, 6 pgs.

C12. R. Chataut, **R. Akl**, "Optimal Pilot Reuse Factor Based on User Environments in 5G Massive MIMO," *IEEE CCWC 2018 The 8th Annual Computing and*

Communication Workshop Conference, January 2018, paper no. 1570413394, 6 pgs.

C13. S. Alotaibi, **R. Akl**, "Radio Resource Management in LTE Femtocell Networks," *IEEE NCA '17 International Symposium on Network Computing and Applications*, November 2017, paper no. 117, 5 pgs.

C14. U. Sawant, **R. Akl**, "Subcarrier Allocation in LTE Network Deployment with Mobility," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference*, October 2017, paper no. 1570349184, 8 pgs.

C15. S. Alotaibi, **R. Akl**, "Packet Scheduling Bandwidth Type-Based Mechanism for LTE," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference*, October 2017, paper no. 1570394639, 6 pgs.

C16. S. Alotaibi, **R. Akl**, "Dynamic Fractional Frequency Reuse (FFR) Scheme for Two-Tier Network in LTE," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference*, October 2017, paper no. 1570394969, 6 pgs.

C17. U. Sawant, **R. Akl**, "Evaluation of Adaptive and Non Adaptive LTE Fractional Frequency Reuse Mechanisms," *IEEE WOCC 2017 The 26th Annual Wireless and Optical Communications Conference*, April 2017, paper no. 1570341174, 6 pgs.

C18. S. Alotaibi, **R. Akl**, "Range-Based Scheme for Adjusting Transmission Power for Femtocells in Co-Channel Deployment," *IEEE WTS 2017 The 16th Annual Wireless Telecommunications Symposium*, April 2017, paper no. 1570334744, 5 pgs.

C19. U. Sawant, **R. Akl**, "A Novel Metric to Study the Performance of Sectorized Fractional Frequency Reuse Techniques in LTE," *IEEE WTS 2017 The 16th Annual Wireless Telecommunications Symposium*, April 2017, paper no. 1570338498, 7 pgs.

C20. S. Alotaibi, **R. Akl**, "Dynamic Frequency Partitioning Scheme for LTE HetNet Networks Using Fractional Frequency Reuse," *IEEE WCNC '17 Wireless Communications and Networking Conference*, March 2017, paper no. 1570332420, 5 pgs., demo and poster.

C21. U. Sawant, **R. Akl**, "Performance Evaluation of Network Productivity for LTE Heterogenous Networks with Reward-Penalty Weights Assessment," *IEEE CCWC 2017 The 7th Annual Computing and Communication Workshop Conference*, January 2017, paper no. 1570328396, 6 pgs.

C22. S. Alotaibi, **R. Akl**, "Self-Adjustment Downlink Transmission Power for Femtocells in Co-Channel Deployment in Heterogeneous Networks," *IEEE CCWC 2017 The 7th Annual Computing and Communication Workshop Conference*, January 2017, paper no. 1570326815, 6 pgs.

C23. U. Sawant, **R. Akl**, "Performance Evaluation of Sectorized Fractional Frequency Reuse Techniques Using Novel Metric," *IEEE ISCC 2016 The Twenty-First IEEE Symposium on Computers and Communications*, June 2016, paper no. 1570275270, 7 pgs.

C24. R. Tidwell, S. Akumalla, S. Karlaputi, **R. Akl**, K. Kavi, and D. Struble, "Evaluating the Feasibility of EMG and Bend Sensors for Classifying Hand Gestures," *1st International Conference on Multimedia and Human Computer Interaction*, July 2013, paper no. 63, 8 pgs.

C25. **R. Akl**, K. Pasupathy, and M. Haidar, "Anchor Nodes Placement for Effective Passive Localization," *2011 IEEE International Conference on Selected Topics in Mobile and Wireless Networks (iCOST)*, October 2011, paper no. 1569490799, pp. 127 - 132.

C26. **R. Akl**, P. Kadiyala, and M. Haidar, "Non-Uniform Grid-Based Routing in Sensor Networks," *9th IEEE Malaysia International Conference on Communications*, December 2009, paper no. 1569243649, pp. 536 - 540.

C27. M. Haidar, M. Al-Rizzo, Y. Chan, **R. Akl**, M. Bouharras, "Throughput Validation of an Advanced Channel Assignment Algorithm in IEEE 802.11 WLAN," *ICCSN 2009 – International Conference on Communication Software and Networks*, February 2009, paper no. P385, pp. 801 - 806.

C28. **R. Akl** and D. Keathly, "Robocamp: Encouraging Young Women to Embrace STEM," 4th Annual TETC Best Practices Conference, February 2009, 13 pgs.

C29. M. Haidar, R. Ghimire, M. Al-Rizzo, **R. Akl**, Y. Chan, "Channel Assignment in an IEEE 802.11 WLAN Based on Signal-to-interference Ratio," *IEEE CCECE – Canadian Conference on Electrical and Computer Engineering: Communications and Networking*, May 2008, paper no. 1569092894, pp. 1169 - 1174.

C30. H. Al-Rizzo, M. Haidar, **R. Akl**, and Y. Chan, "Enhanced Channel Assignment and Load Distribution in IEEE 802.11 WLANs," *IEEE International Conference on Signal Processing and Communication*, November 2007, paper no. 1569042132, pp. 768 - 771.

C31. **R. Akl** and Y. Saravanos, "Hybrid Energy-Aware Synchronization Algorithm in Wireless Sensor Networks," *18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*, September 2007, paper no 692, 5 pgs.

C32. M. Haidar, **R. Akl**, and H. Al-Rizzo, "Channel Assignment and Load Distribution in a Power-Managed WLAN," *18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*, September 2007, paper no. 463, 5 pgs.

C33. D. Keathly and **R. Akl,** "Attracting and Retaining Women in Computer Science and Engineering: Evaluating the Results," *Proceedings of American Society for Engineering Education: ASEE Annual Conference*, June 2007, paper no. AC 2007-1229, 10 pgs.

C34. M. Haidar, **R. Akl**, H. Al-Rizzo, Y. Chan, R. Adada, "Optimal Load Distribution in Large Scale WLAN Networks Utilizing a Power Management Algorithm," *Proceedings of IEEE Sarnoff Symposium*, May 2007, 5 pgs.

C35. R. Dantu, P. Kolan, **R. Akl,** and K. Loper, "Classification of Attributes and Behavior in Risk Management Using Bayesian Networks," *Proceedings of IEEE Intelligence and Security Informatics Conference*, May 2007, pp. 71-74.

C36. **R. Akl** and A. Arepally, "Dynamic Channel Assignment in IEEE 802.11 Networks," *Proceedings of IEEE Portable 2007: International Conference on Portable Information Devices*, March 2007, pp 309-313.

C37. **R. Akl** and U. Sawant, "Grid-based Coordinated Routing in Wireless Sensor Networks," *Proceedings of IEEE CCNC 2007: Consumer Communications and Networking Conference*, January 2007, pp. 860-864.

C38. **R. Akl** and A. Arepally, "Simulation of Throughput in UMTS Networks with Different Spreading Factors," *Proceedings of IEEE VTC Fall 2006: Vehicular Technology Conference*, September 2006, pp. C1-5.

C39. A. Alhabsi, H. Al-Rizzo, and **R. Akl,** "Parity Assisted Decision Making for QAM Modulation," *International Conference on Mobile Computing and Wireless Communications*, September 2006, paper no. 1568988776, 5 pgs.

C40. **R. Akl** and R. Garlick**,** "Retention and Recruitment of Women in Computer Engineering," *ICEE 2006: International Conference on Engineering Education*, July 2006, paper no. 3318, 5 pgs.

C41. R. Garlick and **R. Akl,** "Intra-Class Competitive Assignments in CS2: A One-Year Study," *ICEE 2006: International Conference on Engineering Education*, July 2006, paper no. 3325, 5 pgs.

C42. **R. Akl**, D. Tummala, and X. Li, "Indoor Propagation Modeling at 2.4 GHz for IEEE 802.11 Networks," *WNET 2006: Wireless Networks and Emerging Technologies*, July 2006, paper no. 510-014, 6 pgs.

C43. P. Chen, K. Kavi, and **R. Akl,** "Performance Enhancement by Eliminating Redundant Function Execution," *Proceedings of IEEE: 39th Annual Simulation Symposium*, April 2006, pp. 143-150.

C44. **R. Akl** and S. Nguyen, "Capacity Allocation in Multi-cell UMTS Networks for Different Spreading Factors with Perfect and Imperfect Power Control," *Proceedings of IEEE CCNC 2006: Consumer Communications and Networking Conference*, January 2006, vol. 2, pp. 928-932.

C45. W. Li, K. Kavi, and **R. Akl**, "An Efficient Non-Preemptive Real-Time Scheduling," *18th International Conference on Parallel and Distributed Computing Systems*, Las Vegas, NV, September 2005, pp. 154-160.

C46. S. Nguyen and **R. Akl**, "Approximating User Distributions in WCDMA Networks Using 2-D Gaussian," *CCCC20T 05: International Conference on Computing, Communications, and Control Technologies*, July 2005, 5 pgs.

C47. **R. Akl** and S. Park, "Optimal Access Point Selection and Traffic Allocation in IEEE 802.11 Networks," *Proceedings of 9th World Multiconference on Systemics, Cybernetics and Informatics (WMSCI 2005): Communication and Network Systems, Technologies and Applications*, July 2005, vol. 8, pp. 75-79.

C48. **R. Akl**, M. Naraghi-Pour, M. Hegde, "Throughput Optimization in Multi-Cell CDMA Networks," *IEEE WCNC 2005 - Wireless Communications, and Networking Conference*, March 2005, vol. 3, pp. 1292-1297.

C49. **R. Akl**, "Subscriber Maximization in CDMA Cellular Networks," *Proceedings of CCCT 04: International Conference on Computing, Communications, and Control Technologies*, August 2004, vol. 3, pp. 234-239.

C50. **R. Akl** and A. Parvez, "Global versus Local Call Admission Control in CDMA Cellular Networks," *Proceedings of CITSA 04: Communications, Information and Control Systems, Technologies and Applications*, July 2004, vol. 2, pp. 283-288.

C51. **R. Akl** and A. Parvez, "Impact of Interference Model on Capacity in CDMA Cellular Networks," *Proceedings of SCI 04: Communication and Network Systems, Technologies and Applications*, July 2004, vol. 3, pp. 404-408. Selected as **best paper** of those presented in the session: Tele-Communication Systems, Technologies and Application II.

C52. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Call Admission Control Scheme for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Wireless Communications and Networking Conference*, September 2000, vol. 1, pp. 465-470.

C53. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Cell Placement in a CDMA Network," *IEEE Wireless Communications and Networking Conference*, September 1999, vol. 2, pp. 903-907.

C54. **R.G. Akl**, M.V. Hegde, P.S. Min, "Effects of Call Arrival Rate and Mobility on Network Throughput in Multi-Cell CDMA," *IEEE International Conference on Communications*, June 1999, vol. 3, pp. 1763-1767.

C55. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology Conference*, May 1999, vol. 2, pp. 1643-1647.

Journal Publications

J1. R. Chataut, **R. Akl**, "Massive MIMO Systems for 5G and Beyond Networks – Overview, Recent Trends, Challenges, and Future Research Direction," *Sensors 2020*, 20(10), 2753, May 2020.

J2. R. Chataut, **R. Akl,** "Massive MIMO Systems for 5G," *Encyclopedia 2020*, doi:10.32545, 2020, (ISSN 2309-3366).

J3. S. Alotaibi, **R. Akl**, "Range-Based Scheme for Adjusting Transmission Power of Femtocell in Co-Channel Deployment," *International Journal of Interdisciplinary Telecommunications and Networking*, IJITN Vol. 10, No. 4, pgs. 14-24, 2018.

J4. U. Sawant, **R. Akl**, "Adaptive and Non Adaptive LTE Fractional Frequency Reuse Mechanisms Mobility Performance," *Advances in Science, Technology and Engineering Systems Journal*, ASTES Vol. 3, No. 3, 02-11, 11 pgs., 2018.

J5. M. Haidar, H.M. Al-Rizzo, **R. Akl**, and Z. Elbazzal, "The Effect of an Enhanced Channel Assignment Algorithm in an IEEE 802.11 WLAN," *World Scientific and Engineering Academy and Society Transactions on Communications*, WSEAS, Vol. 8, Issue 12, December 2009.

J6. **R. Akl**, P. Kadiyala, and M. Haidar, "Non-Uniform Grid-Based Coordinated Routing in Wireless Sensor Networks," *Journal of Sensors*, article ID 491349, volume 2009, 11 pages.

J7. M. Haidar, M. Al-Rizzo, Y. Chan, **R. Akl**, "User-Based Channel Assignment Algorithm in a Load-Balanced IEEE 802.11 WLAN," *International Journal of Interdisciplinary Telecommunications & Networking (IJITN)*, April-June 2009, 1(2), pp. 66-81.

J8. **R. Akl**, D. Keathly, and R. Garlick, "Strategies for Retention and Recruitment of Women and Minorities in Computer Science and Engineering," *iNEER Special*

Volume: Innovations 2007- World Innovations in Engineering Education and Research, 9 pgs., 2007.

J9. R. Garlick and **R. Akl**, "Motivating and Retaining CS2 Students with a Competitive Game Programming Project," *iNEER Special Volume: Innovations 2007- World Innovations in Engineering Education and Research*, 9 pgs., 2007.

J10. **R. Akl** and S. Nguyen, "UMTS Capacity and Throughput Maximization for Different Spreading Factors," *Journal of Networks*, July 2006, vol. 1, issue 3, pp. 40-49. ISSN: 1796-2056

J11. W. Li, K. Kavi, and **R. Akl**, "A Non-preemptive Scheduling Algorithm for Soft Real-time Systems," *Journal of Computer and Electrical Engineering*, 2006, vol. 32, 18 pgs. ISSN: 0045-7906

J12. **R. Akl**, A. Parvez, and S. Nguyen, "Effects of Interference on Capacity in Multi-Cell CDMA Networks," *Journal of Systemics, Cybernetics and Informatics*, 2006, vol. 3, no. 1, p825612, 7 pgs. ISSN: 1690-4524

J13. **R.G. Akl**, M. Hegde and M. Naraghi-Pour, "Mobility-based CAC Algorithm for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Transactions on Vehicular Technology*, March 2005, vol. 54, no. 2, pp. 639-651.

J14. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Multi-Cell CDMA Network Design," *IEEE Transactions on Vehicular Technology*, May 2001, vol. 50, no. 3, pp. 711-722.

Technical Papers

T1. J. Williams, **R. Akl,** et al, "Flight Control Subsystem," *The Eagle Feather*, Special Section: Undergraduate Research Initiative in Engineering, University of North Texas, Vol. 7, 2010.

T2. **R.G. Akl**, M.V. Hegde, A. Chandra, P.S. Min, "CDMA Capacity Allocation and Planning," Technical Document, Washington University Department of Electrical Engineering WUEE-98, April 1998.

Book Chapters

B1. R. Akl, Y. Saravanos, and M. Haidar, "Chapter 18: Hybrid Approach for Energy-Aware Synchronization in Sensor Networks," *Sustainable Wireless Sensor Networks*, December 2010, pgs. 413-429, ISBN: 978-953-307-297-5.

B2. K. Kavi, **R. Akl** and A. Hurson, "Real-Time Systems: An Introduction and the State-of-the-Art," *Encyclopedia of Computer Science and Engineering*, John Wiley & Sons, Volume 4, January 2009, pgs. 2369-2377.

B3. **R. Akl** and K. Kavi, "Chapter 12: Modeling and Analysis using Computational Tools," *Introduction to Queuing Theory: Modeling and Analysis*, Birkhauser Boston, December 2008, pgs. 295-320.

Technical Presentations

P1. "Bio-Com Project," Raytheon, Richardson TX, May 2012, (invited).

P2. "Bio-Com Project," Net-Centric Software and Systems I/UCRC Meeting, Denton TX, December 2011, (invited).

P3. "Student Outreach Report: Robocamp," College of Engineering Advisory Board Meeting, Denton TX, May 2011, (invited).

P4. "Robocamp: Encouraging Young Women to Embrace STEM," 4th Annual TETC Best Practices Conference, Austin TX, February 2009, (invited).

P5. "Self-Configuring Wireless MEMS Network (demo)," Southern Methodist University, Dallas TX, January 2008, (invited).

P6. "Energy-aware Routing and Hybrid Synchronization in Sensor Networks," *Southern Methodist University*, Dallas TX, September 2007, (invited).

P7. "Retention and Recruitment of Women in Computer Engineering," *ICEE 2006: International Conference on Engineering Education*, Puerto Rico, July 2006, (refereed).

P8. "Capacity Allocation in Multi-cell UMTS Networks for Different Spreading Factors with Perfect and Imperfect Power Control," *IEEE CCNC 2006: Consumer Communications and Networking Conference*, Las Vegas, NV, January 2006, (refereed).

P9. "Research, Teaching, and Outreach," CSE Advisory Council Meeting, *UNT Research Park*, Denton, TX, December 2005, (invited).

P10. "Wi-Fi and WCDMA Network Design," *University of Arkansas*, Little Rock, AR, April 2005, (invited).

P11. "Wi-Fi and WCDMA Network Design," *Southern Methodist University*, Dallas, TX, March 2005, (invited).

P12. "Current Research in Wireless at UNT," *Nortel Networks*, Richardson, TX, October 2004, (invited).

P13. "Subscriber Maximization in CDMA Cellular Networks," *International*

Conference on Computing, Communications, and Control Technologies, Austin, TX, August 2004, (refereed).

P14. "Global versus Local Call Admission Control in CDMA Cellular Networks," *International Conference on Cybernetics and Information Technologies, Systems and Applications*, Orlando, FL, July 2004, (refereed).

P15. "Impact of Interference Model on Capacity in CDMA Cellular Networks," *8th World Multi-Conference on Systemics, Cybernetics, and Informatics*, Orlando, FL, July 2004, (refereed).

P16. "CDMA Network Design," IEEE Communications Society – New Orleans Chapter, New Orleans, LA, May 2002, (invited).

P17. "Cell Design to Maximize Capacity in CDMA Networks," Louisiana State University, Baton Rouge, LA, April 2002, (invited).

P18. "Call Admission Control Scheme for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Wireless Communications and Networking Conference*, Chicago, IL, September 2000, (refereed).

P19. "Cell Placement in a CDMA Network," *IEEE Wireless Communications and Networking Conference*, September 1999, (refereed).

P20. "Effects of Call Arrival Rate and Mobility on Network Throughput in Multi-Cell CDMA," *IEEE International Conference on Communications*, June 1999, (refereed).

P21. "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology Conference*, May 1999, (refereed).

P22. "CCAP: A Strategic Tool for Managing Capacity of CDMA Networks," Teleware Co. Ltd., Seoul, South Korea, 1998, (invited).

Courses Developed

- CSCE 5933: LTE Physical Layer Using MATLAB.
  Research issues in the design of LTE physical layer and simulate using MATLAB. Topics include modulation and coding, OFDM, channel modeling, MIMO, and link adaption.

- CSCE 6590: Advanced Topics in Wireless Communications & Networks: 4G/LTE.
  Research issues in the design of next generation wireless networks: cellular systems, medium access techniques, signaling, mobility management, control and management for mobile networks, wireless data networks, Internet mobility,

quality-of-service for multimedia applications, caching for wireless web access, and ad hoc networks.

- CSCE 5933: Fundamentals of VoIP.
  Fundamentals of VoIP, with emphasis on network infrastructure implementation and security. Topics include IP protocol suite, SS7, speech-coding techniques, quality of service, session initiation protocol, and security issues.

- CSCE 5540: Introduction to Sensor Networks.
  Topics include: design implications of energy (hardware and software), and otherwise resource-constrained nodes; network self-configuration; services such as routing under network dynamics, localization, time-synchronization and calibration; distributed data management, in-network aggregation and collaborative signal processing, programming tools and language support.

- CSCE 5510. Wireless Communication.
- Point-to-point signal transmission through a wireless channel, channel capacity, channel encoding, and multi-user transmissions. First, second, and third generation cellular systems, and mobility management.

- CSCE 3510. Introduction to Wireless Communication.
  Fundamentals of wireless communications and networking, with emphasis on first, second, and third generation cellular systems. Topics include point-to-point signal transmission through a wireless channel, cellular capacity, multi-user transmissions, and mobility management.

- CSCE 3020. Communications Systems.
  Introduction to the concepts of transmission of information via communication channels. Amplitude and angle modulation for the transmission of continuous-time signals. Analog-to-digital conversion and pulse code modulation. Transmission of digital data. Introduction to random signals and noise and their effects on communication. Optimum detection systems in the presence of noise.

- ENEE 3583. Computer Systems Design I (UNO).
  The design process of digital computer systems is studied from the instruction set level, system architecture level, and digital logic level. Topics include machine organization, register transfer notation, processor design, memory design, and input/output considerations. Includes semester project.

- ENEE 3584. Computer Systems Design II (UNO).
  The design and evaluation of contemporary computer systems are analyzed to compare the performance of different architectures. Topics include performance metrics, computer arithmetic, pipelining, memory hierarchies, and multiprocessor systems.

- ENEE 3514. Computer Architecture Laboratory (UNO).

Selected experiments examining programmable logic, VHDL and logic synthesis, and including a final design project, to accompany and complement the lecture course ENEE 3584. Three hours of laboratory.

Courses Taught

Fall 2021
- CSCE 3010.1: Signals and Systems (no evaluation yet)
- CSCE 5933.1: LTE Physical Layer Using MATLAB
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2021
- CSCE 2610.2: Computer Organization (no evaluation yet)
- CSCE 3020.1: Communication Systems (no evaluation yet)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2020
- CSCE 3010.1: Signals and Systems (4.1 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2020
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2019
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.3 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2019
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: Software Defined Radios (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2018
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.8 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2018
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: Jitter-buffer Management and Interference in VoIP (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2017
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.9 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: VoLTE and VoWiFi (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2017
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2016
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.7 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2016
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2015
- CSCE 3010.1: Signals and Systems (5.7 / 7.0)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2015
- CSCE 5934.743: Directed Study (no evaluation done)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2014
- CSCE 3010.1: Signals and Systems (3.32 / 4.00)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)
- CSCE 6590.1: Advanced Topics in Wireless Communications & Networks: 4G/LTE (3.79 / 4.00)

Spring 2014
- CSCE 3510.1: Intro to Wireless Communication (808 – Highly Effective)
- CSCE 5510.1: Wireless Communications (808 – Highly Effective)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2013
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)
- CSCE 6590.1: Advanced Topics in Wireless Communications & Networks: 4G/LTE (804 – Highly Effective)

Spring 2013
- CSCE 4890.743: Directed Study (no evaluation done)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6940.743: Individual Research (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2012
- CSCE 3010.1: Signals and Systems (793 – Highly Effective)
- CSCE 5540.1: Intro to Sensor Networks (814 – Highly Effective)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2012
- CSCE 3020.1: Communication Systems (809 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (811 – Highly Effective)
- CSCE 5510.1: Wireless Communications (817 – Highly Effective)

- EENG 3810.1: Communication Systems (801 – Highly Effective)

Fall 2011
- CSCE 3010.1: Signals and Systems (793 – Highly Effective)
- CSCE 5540.1: Intro to Sensor Networks (824 – Highly Effective)

Spring 2011
- CSCE 3020.1: Communication Systems (820 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (812 – Highly Effective)
- CSCE 5510.1: Wireless Communications (812 – Highly Effective)
- EENG 3810.1: Communication Systems (826 – Highly Effective)

Fall 2010
- CSCE 3010.1: Signals and Systems (857 – Highly Effective)
- CSCE 5540.1: Intro to Sensor Networks (831 – Highly Effective)

Spring 2010
- CSCE 3020.1: Communication Systems (792 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (793 – Highly Effective)
- CSCE 5510.1: Wireless Communications (834 – Highly Effective)
- EENG 3810.1: Communication Systems (854 – Highly Effective)

Fall 2009
- CSCE 3010.1: Signals and Systems (4.40 / 5.00)
- CSCE 5540.1: Intro to Sensor Networks (4.70 / 5.00)
- EENG 2620.1: Signals and Systems (4.40 / 5.00)

Spring 2009
- CSCE 3020.1: Communication Systems (4.87 / 5.00)
- CSCE 3510.1: Intro to Wireless Communication (4.65 / 5.00)
- CSCE 5510.1: Wireless Communications (4.79 / 5.00)

Fall 2008
- CSCE 3010.1: Signals and Systems (4.91 / 5.00)
- CSCE 5540.2: Intro to Sensor Networks (4.10 / 5.00)
- EENG 2620.3: Signals and Systems (4.91 / 5.00)

Spring 2008
- CSCE 3020.1: Communication Systems (4.68 / 5.00)
- CSCE 3510.1: Intro to Wireless Communication (3.96 / 5.00)
- CSCE 5510.1: Wireless Communications (4.75 / 5.00)

Fall 2007
- CSCE 3010.1: Signals and Systems (4.57 / 5.00)
- CSCE 5540.2: Intro to Sensor Networks (4.01 /5.00)

Summer 2007
- CSCE 3020.1: Fund. of Communication Theory (no evaluation done)
- EENG 3810.1: Communication Systems (no evaluation done)

Spring 2007
- CSCE 5510.2: Wireless Communications (4.75 / 5.00)
- CSCE 5933.6: Fundamentals of VoIP (4.70 / 5.00)

Fall 2006
- CSCE 3010.1: Signals and Systems (4.58 / 5.00)

- CSCE 5540.1: Intro to Sensor Networks (4.70 / 5.00)
- EENG 2620.1: Signals and Systems (4.58 / 5.00)

Summer 2006

- CSCE 3020.1: Fund. of Communication Theory (no evaluation done)
- CSCE 3510.21: Intro to Wireless Communications (no evaluation done)
- CSCE 5510.21: Intro to Wireless Communications (no evaluation done)
- EENG 3810.1: Communication Systems (no evaluation done)

Spring 2006

- CSCE 2610.2: Computer Organization (3.69 / 5.00)
- CSCE 3010.1: Signals and Systems (4.41 / 5.00)
- EENG 2620.1: Signals and Systems (4.41 / 5.00)

Fall 2005

- CSCE 3510.1: Intro to Wireless Communications (4.52 / 5.00)
- CSCE 5510.1: Wireless Communications (4.46 / 5.00)
- CSCE 5933.6: Intro to Sensor Networks (4.60 / 5.00)

Summer 2005

- CSCE 3010.21: Signals and Systems (no evaluation done)
- CSCE 3510.21: Intro to Wireless Communications (no evaluation done)

Spring 2005

- CSCE 3510.02: Intro to Wireless Communications (4.46 / 5.00)
- CSCI 3100.02: Computer Organization (4.14 / 5.00)

Fall 2004

- CSCE 3510.01: Intro to Wireless Communications (4.15 / 5.00)
- CSCI 4510.01: Machine Structures (4.55 / 5.00)
- CSCI 5330.02: Intro to Wireless Communications (4.05 / 5.00)

Summer 2004

- CSCI 4330.22: Intro to Wireless Communications (no evaluation done)
- CSCI 4330.23: Intro to Wireless Communications (no evaluation done)
- CSCI 5330.22: Intro to Wireless Communications (no evaluation done)

Spring 2004

- CSCI 3100: Computer Organization (4.64 / 5.00)
- CSCI 4330: Intro to Wireless Communications (4.22 / 5.00)

Fall 2003

- CSCI 4510: Machine Structures (4.49 / 5.00)
- CSCI 5330: Intro to Wireless Communications (4.83 / 5.00)

Summer 2003

- CSCI 3100: Computer Organization (no evaluation done)

Spring 2003

- CSCI 3100: Computer Organization (3.84 / 5.00)

Fall 2002

- CSCI 4510: Machine Structures (4.38 / 5.00)

Funded Proposals

R1. "I/UCRC Industrial Membership - Ashum Corp," 2020. Krishna Kavi (PI), Robert Akl (co-PI), **$52,000.**

R2. "I/UCRC Industrial Membership - Ashum Corp," 2019. Krishna Kavi (PI), Robert Akl (co-PI), **$60,900.**

R3. "I/UCRC Industrial Membership - Ashum Corp," 2018. Krishna Kavi (PI), Robert Akl (co-PI), **$57,700.**

R4. "Robotics and App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $11,727. Submitted 5/5/17. Robert Akl (PI), **$11,727.**

R5. "I/UCRC Industrial Membership - Ashum Corp," 2017. Krishna Kavi (PI), Robert Akl (co-PI), **$50,000.**

R6. "UNT GenCyber Summer Program: Inspiring the Next Generation of Cyber Stars in North Texas," National Security Agency (NSA). Requested amount is $85,000. Submitted 11/4/2016. Robert Akl (co-PI), **$85,000**.

R7. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $12,900. Submitted 5/6/16. Robert Akl (PI), **$12,900.**

R8. "I/UCRC Industrial Membership - Ashum Corp," 2016. Krishna Kavi (PI), Robert Akl (co-PI), **$65,000.**

R9. "Robotics, Game and App Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 11/16/15. Robert Akl (PI), **$63,000**.

R10. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $13,998. Submitted 5/1/15. Robert Akl (PI), **$13,988**.

R11. "I/UCRC Industrial Membership - Ashum Corp," 2015. Krishna Kavi (PI), Robert Akl (co-PI), **$40,000.**

R12. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $12,500. Submitted 5/2/14. Robert Akl (PI), **$12,500**.

R13. "I/UCRC Industrial Membership - Ashum Corp," 2014. Krishna Kavi (PI), Robert Akl (co-PI), **$46,000.**

R14. "I/UCRC Industrial Membership - Ashum Corp," 2013. Krishna Kavi (PI), Robert Akl (co-PI), **$38,500.**

R15. "Robotics, Game and App Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 12/14/12. Robert Akl (PI), **$63,000**.

R16. "Bio-Com Project," funded by Raytheon under Net-Centric Software and Systems I/UCRC 2nd year. Requested amount is $30,000. Submitted 5/12/12. Krishna Kavi (PI), Robert Akl (co-PI), **$30,000.**

R17. "Bio-Com Project," funded by Raytheon under Net-Centric Software and Systems I/UCRC. Requested amount is $30,000. Submitted 5/12/11. Krishna Kavi (PI), Robert Akl (co-PI), **$30,000.**

R18. "Game Programming for Xbox 360 Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $20,000. Submitted 3/21/11. Robert Akl (PI), **$20,000**.

R19. "RoboCamps and Game Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 2/17/11. Robert Akl (PI), **$63,000**.

R20. "Game Programming for Xbox 360 Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $13,000. Submitted 2/22/10. Robert Akl (PI), **$18,000.**

R21. "Robotics and Game Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 10/16/09. Robert Akl (PI), **$63,000**.

R22. "Micro Air Vehicle Design: A Collaborative Undergraduate Project for Electrical Engineering, Computer Engineering, and Computer Science Students," under UNT Undergraduate Research Initiative. Submitted 9/25/2009. Robert Akl (co-PI), **$8,000**.

R23. "Summer Merit Program" under Texas Workforce Commission. Requested amount is $42,000. Submitted 3/20/09. Robert Akl (PI), **$42,000**.

R24. "Robocamp at Stewpot" under Dallas Women's Foundation. Requested amount is $20,000. Submitted 2/23/09. Robert Akl (PI), **$18,600**.

R25. "Robocamp Jump Start" under Motorola Foundation Innovation Generation Grant. Requested amount is $29,852. Submitted 2/12/09. Robert Akl (PI), **$30,700**.

R26. "Engineering Summer Program" under Texas Higher Education Coordinating Board. Requested amount is $7,944. Submitted 2/13/09. Robert Akl (PI), **$11,111**.

R27. "Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $152,393. Submitted 11/10/08. Robert Akl (PI), **$152,393**.

R28. "I/UCRC Center Proposal: Net-Centric Software and Systems," under NSF-07-537: Industry/University Cooperative Research Centers. Requested amount is $349,482. Submitted 9/26/08. Krishna Kavi (PI), Robert Akl (co-PI), **$60,000 per year for 5 years**.

R29. "Robocamp and Beyond" under Motorola Foundation Innovation Generation Grant. Requested amount is $30,000. Submitted 6/20/08. Robert Akl (PI), **$30,000**.

R30. Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $30,000. Submitted 2/27/08. Robert Akl (PI), **$31,500**.

R31. "Robocamp Program for Young Women" under RGK foundation. Requested amount is $30,000. Submitted 11/5/07. Robert Akl (PI), **$15,000**.

R32. "Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $102,514. Submitted 10/22/07. Robert Akl (PI), **$102,514**.

R33. "Women Art Technology" under Hispanic and Global Studies Initiatives Fund. Requested amount is $14,125. Submitted 9/30/07. Jennifer Way (PI), Robert Akl (co-PI), **$12,785**.

R34. "Robocamp Mobile Unit" under Motorola Foundation Innovation Generation Grant. Requested amount is $35,000. Submitted 6/20/07. Robert Akl (PI), **$30,000**.

R35. "ICER: UNT Engineering Challenge Camps" under NSF 0547299. Requested amount is $35,000. Submitted 4/27/07. Oscar Garcia (PI), Robert Akl (senior personnel), **$32,792**.

R36. "I/UCRC-Planning Proposal: UNT Research Site Proposal to join Embedded Systems I/UCRC," under NSF-01-116: Industry/University Cooperative Research Centers. Requested amount is $10,000. Submitted 3/31/07. Krishna Kavi (PI), Robert Akl (co-PI), **$10,000**.

R37. "High-assurance NCCS: Ultra Dependability Integration Engineering," Department of Defense. Requested amount is $20,000. Submitted 3/12/07. Krishna Kavi (PI), Robert Akl (co-PI), **$20,000**.

R38. "Recruiting and Retention Strategies for Computer Science at UNT" under Texas Technology Workforce Development Grant Program – 2005. Requested amount is $163,322. Submitted 3/17/05. Robert Akl (PI), **$125,322**.

R39. UNT Faculty Research Grant for Fall 2003, Robert Akl (PI), $5,000, **$4,000**.

R40. UNT Junior Faculty Summer Research Fellowship for Summer 2003, Robert Akl (PI), $5,000, **$5,000**.

Professional Associations and Achievements

Membership in Professional Organizations

- Senior Member IEEE
- Member, Federation Council of North Texas Universities
- Member, Eta Kappa Nu Electrical Engineering Honor Society
- Member, Golden Key National Honor Society
- Member, Tau Beta Pi Engineering Honor Society

Offices and Committee Assignments in Professional Organizations

- Technical Program Committee Member, IEEE Wireless Communications and Networking Conference, IEEE WCNC
- Technical Program Committee Member, International Wireless Symposium, IWS
- Technical Program Committee Member, IEEE International Conference on Computational Science, IEEE ICCS
- Technical Program Committee Member, IASTED International Conference on Wireless Communications, WC
- Technical Program Committee Member, WTS Wireless Telecommunications Symposium
- Technical Program Committee Member, Mosharaka International Conference on Computer Science and Engineering, Amman
- Invitation to serve as an NSF reviewer/panelist for Engineering Research Centers (ERC) proposals
- Technical Program Committee Member, 18th IEEE International Symposium on Personal, Indoor and Mobile Radio Communication, Greece
- International Program Committee, IASTED International Conference on Wireless and Optical Communication, Canada
- Program Committee Member, Fifth Annual Wireless Telecommunications Symposium, CA
- Technical Publications Chair, IEEE Vehicular Technology Conference, Dallas TX
- Session Chair, International Conference on Computing, Commun. and Control Tech., Austin TX
- Session Chair, International Conference on Cybernetics and Information Technologies, Orlando FL

- Session Chair, 8th World Multi Conference on Systemics, Cybernetic, and Informatics, Orlando FL

Additional Responsibilities and Activities

- Reviewer, *Wireless Communications and Mobile Computing*, 2012 – present
- Reviewer, *Journal of Sensor and Actuator Networks*, 2012 – present
- Reviewer, *IEEE Transactions on Vehicular Technology*, 2011 – present
- Reviewer, *Elsevier Journal of Computers & Electrical Engineering*, 2008 – present
- Reviewer, *IEEE Globecom*, 2007 – present
- Reviewer, *IEEE International Conference on Advanced Networks and Telecommunication Systems (ANTS)*, 2008 – present
- Reviewer, *The International Wireless Communications and Mobile Computing Conference*, 2007 – present
- Reviewer, *Journal on Wireless Communications and Networking*, 2007 – present
- Reviewer, *IEEE Transactions on Communications*, 2007 - present
- Reviewer, *International Journal of Communication Systems*, 2007 – present
- Reviewer, *IEEE Communications Magazine*, 2005 – present
- Reviewer, *Journal of Wireless Networks*, 2004 – present
- Reviewer, *IEEE Transactions on Mobile Computing*, 2004 – present
- Reviewer, *IEEE Transactions on Wireless Communications*, 2004 – present
- Reviewer, *ACM Crossroads*, 2004 – present

Honors and Awards

- Who's Who in America, 2012 Edition
- Winner of Tech Titan of the Future – University Level Award for UNT Robocamps for Girls, Metroplex Technology Business Council, 2010 with **$15,000 cash prize**.
- IEEE Professionalism Award, Ft Worth Chapter, 2008
- UNT College of Engineering Outstanding Teacher Award, 2008
- Certificate of Appreciation: IEEE Vehicular Technology Conference, Dallas, TX, 2005
- Certificate of Appreciation: Denton County Boosting Engineering, Science and Technology (BEST) Robotics Competition, 2004
- Summa Cum Laude Graduate, Ranked First in Undergraduate Class
- The Computer Science Departmental Award for Academic Excellence, Washington University, 1993
- The Dual Degree Engineering Award for Outstanding Senior, Washington University, 1993
- The 1992 Technical Writing Competition Award, The Society for Technical Communication